THE TEACHER'S MANUAL OF
OBJECT LESSONS
IN
DOMESTIC ECONOMY

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ADAPTED TO MEET THE REQUIREMENTS OF
THE EDUCATION DEPARTMENT
IN THE
CLASS SUBJECT OF DOMESTIC ECONOMY
AS LAID DOWN IN THE CODE
FOR 1898

BY VINCENT T. MURCHÉ

AUTHOR OF DOMESTIC SCIENCE READERS (I.–VII.); SCIENCE READERS (I.–VI.);
OBJECT LESSONS IN ELEMENTARY SCIENCE; OBJECT LESSONS
FOR INFANTS

VOL. II.
(STANDARDS III. AND IV.)

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PREFACE

THE "**Object Lessons in Elementary Science**" have met with such hearty approval from the Highest Educational Authority, from H.M. Inspectors in all parts of the country, from the Training Colleges, and from the Press, and have been so universally adopted by the teaching profession in public and private schools, both at home and abroad, that Author and Publishers alike have been encouraged to launch a companion series, dealing with the subject of Domestic Economy.

Like their predecessors these books are essentially Teachers' Manuals, and the lessons in both follow on precisely the same lines, as regards arrangement and method of treatment — the guiding principle throughout being "*from the known to the unknown, and that by easy natural stages, so that each step may suggest the next.*"

By this mode of treatment the child's interest is aroused from the first, because she is able to find out something for herself; the next step is that she **tries to think for herself**, and then the rest is comparatively easy.

Each lesson becomes, in fact, not merely a vehicle for conveying some specific teaching, but **an actual training ground for future observation** and deduction on the things which the child meets with in its everyday life.

These Manuals are designed primarily to meet the **requirements of the Education Department** in the Class Subject of **Domestic Economy**, as laid down in the **Code for 1898.** But it is anticipated that they will have a much wider field of usefulness as **Handbooks of Object**

Lessons for Teachers generally, and not for those only who are interested in that particular Class Subject.

In these, as in the companion series, the Author has considered the Teacher as well as the children. His aim has been to assist as much as possible in **training the young teacher in the Art of teaching.** It is for this reason that the lessons are all written in full,—not to slavishly bind any one, and so destroy or even weaken her own individuality, but to point out from the first the true logical sequence of each step as she proceeds.

The teacher should ever remember that no Object Lesson on any subject is worthy of its name unless it is amply **illustrated with the objects themselves**; and, keeping this in view, the Author ventures to repeat the advice given in the Manuals on Elementary Science, viz. "*Never use a picture where the real object can (with a little trouble) be obtained.*"

At the same time, of course, pictures are indispensable with certain subjects; but each teacher should try with the utmost care to cultivate dexterity in the use of blackboard, chalk, and duster, for these, after all, in a deft hand will make the most graphic pictures.

"*It is intended,*" says the Code (1898), "*that the instruction,*" in this and its kindred subject Elementary Science, "*shall be given mainly by experiment and illustration*"; and my Lords add that "*if these subjects are taught by definition and verbal description, instead of making the children exercise their own powers of observation, they will be worthless as a means of education.*"

In accordance with these very explicit requirements of the Department, **simple experiment has been made the basis of all the teaching** in this course.

This book (Vol. II. of the Series) deals with the work prescribed for Standards III. and IV., viz.: (*a*) The Materials used in Clothing and Washing; (*b*) Food, its composition—Clothing, Washing.

The Code distinctly states that "*the Chemistry of Food must not form part of a Scheme for Standard IV.,*" and consequently the physical properties only of food are taught here. THERE IS NO REFERENCE OF ANY KIND TO CHEMISTRY.

The Chemistry of Food will follow naturally in a later stage.

In conclusion, it should be noted that these, the Teachers' Manuals, are the outcome of the cordial reception which has been given to the already existing **Domestic Science Readers** for the children. They have been prepared in response to the appeal of a large number of Teachers, and it is earnestly hoped that the two will run side by side—**the Readers as the natural complement of the Teachers' Object Lessons,** for this again is in strict accord with the requirements of the Education Department.

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STANDARD III

PART I.—MATERIALS USED FOR CLOTHING

PART II.—MATERIALS USED IN WASHING

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GOVT. NORMAL ✱ HOOGHLY ✱ SCHOOL.

STANDARD III

Lesson I

A FIRST CHAT ABOUT CLOTHES

Provide for illustration a couple of well-dressed dolls, fully equipped in walking-out costumes, one for summer, the other for winter—a live frog in a glass bowl, a kitten, a rabbit, or some other domestic pet—a small bag of feathers.

I. DOLLY'S CLOTHES

PRODUCE the dolls, and it will be at once an easy matter to excite the interest and command the attention of the girls. Hand the dolls round the class for inspection, and lead the children to examine the various articles of clothing one by one. In the hands of a sympathetic teacher the girls will soon become absorbed and delighted with the dolls.

I am glad you are pleased with my two dolls, girls, for we are going to have a chat about their clothes now. They are dressed like two little ladies, who have just been out walking; but you see they are not dressed alike, although they both look very pretty.

When would you expect to see a lady dressed like this one? In the summer-time.

Why? Because she is dressed in **light thin clothes** and they would not do for the cold weather.

Quite right. The other, you see, is wrapped up close in **a thick dress and jacket,** made of some **dark-**

coloured material. This is the sort of dress we always wear in the **cold winter weather.** I have dressed our two dolls, of course, to make them look smart and pretty, but our own clothes have a much more important purpose than that. We will see what this purpose is presently, but meanwhile I want two girls to come out and undress the dolls for me, so that we may carefully examine all their clothing.

Select two girls to do this, and have the articles of clothing from each doll placed separately on the table. Lead the girls themselves to notice the difference between the two sets of clothing. Point out that this difference is not in the outer garments only, but in stockings, petticoats, and underclothing as well; and show from this that **we do not change our clothing simply for appearance.**

By dressing our dolls as we dress ourselves, I have led you to think of the entire change we make in our clothing to suit winter and summer. Now let us try to find out why we do this. A glance at some of the animals around us will make it all clear.

II. WARM BLOOD AND COLD BLOOD

Produce the frog and the kitten. Compare the two animals rapidly, one with the other, and show that they are unlike in nearly every respect. Explain that, for the present, we shall leave everything else, and consider only the clothing of these two animals.

Look at the kitten first. How is her body clothed? She has a coat of **thick, soft, smooth hair.**

Do you know any other animal that has a coat very much like the cat's coat? The rabbit.

Quite right. We call the thick, soft, smooth coat of the cat and the rabbit, **fur**; and it is **very warm** as well as **very thick.**

Now look at the frog. What kind of coat has this animal?

The children should be allowed to look at the frog through the *glass, but not to handle it for the present, and this will make the question somewhat puzzling to them.*

Point out that the frog has nothing but **a thin, smooth skin** *to cover its body.* **The body** *in fact is* **quite naked.**

Lead them to tell, from their own observation, that the frog spends much of its time swimming about in the water. How cold the little creature must be in the water, with no covering for its naked skin.

Tell that the cat, even with that thick fur coat to cover her, would die with the cold if she were kept in the water; and yet the frog swims about, and seems happy enough. How is this?

Ask for a volunteer to come and take the frog out of the bowl now. There will be no difficulty in getting one of the girls in the class to do it, although, of course, frogs are not general favourites.

What is the first thing you notice when you pick up the frog? **It feels cold and clammy** all over its body.

Does the cat's body feel cold and clammy too, when you touch it? No! **her body is always warm.**

That is right. The cat's body, like ours, **always feels warm,** and the reason is that **she has warm blood** flowing all through her body just as we have. It is this warm blood flowing about that **makes her body warm.**

The frog has blood too, **but its blood is cold,** and therefore cannot make its body warm. **It is always cold**; it **always was cold**; it **always will be cold.**

Now, I think we can understand why the cat has a thick fur coat, and the frog nothing but a naked skin as a covering for its body. The warm blood **makes the cat's body warm** all over, but if she had only a naked skin, the warmth would soon pass away; her body would get cold, and she would die. Her thick fur coat **keeps the warmth in,** so that she does not get cold.

The body of the frog is cold **because its blood is cold**; it has no warmth to keep in, and therefore **it has no need of a thick warm coat.**

Lead the children to mention other familiar animals, such as sheep and dogs, which have thick warm coats; and then produce the bag of feathers. What are these? Where did they come from? Let one of the children thrust her hand into the middle of the feathers. **They feel warm.**

Tell that **birds,** *like sheep, dogs, cats, and rabbits,* **have warm blood,** *and they are clothed in this light warm covering of feathers,* **to keep their bodies warm.**

What kind of clothing have fishes? Explain that fishes, like frogs, are **cold-blooded animals.** *They have no warmth in their bodies; therefore* **they do not need a thick coat.**

III. Our Clothes

Like the birds and beasts around us **we** too have **warm blood**; but can you tell me one great difference between them and us? They all have a covering for their bodies, but **our bodies are naked.**

Explain that each animal has its proper home in some particular part of the world. One is found **only in very hot lands,** *another lives among* **perpetual ice and snow;** *but all are clothed to suit their own particular homes, and* **they cannot live far away from those places.**

Man was meant, not to be a fixture to any one part of the world, but to spread all over the globe, without regard to heat or cold, and it is **our naked skin** *which makes this possible.*

But why can we do without a covering for our bodies better than other living creatures? Because we are able to make clothing for ourselves.

Yes, man is an intelligent being, and **can clothe himself** to suit his needs in any part of the world, and in all seasons of the year. He watches the birds and beasts, and follows their example; that is all.

Remind the children of the **moulting season** *with birds. Explain the purpose of this moulting—to provide the creatures with* **a thicker, more suitable covering,** *before the approach of the cold season. On the other hand, call attention* *to the way in which pussy's coat falls out in the summer time, because* **a thick coat is not wanted then.** *The warmer the weather gets, the more the hairs fall out, so that in the very hot weather the coat is quite thin; we cannot take her up in our laps without covering our frocks with hairs. Explain, too, that as the old coat falls off, little new hairs grow up in their places,* **to make a thick warm coat** *in readiness for the return of the cold season.*

We in like manner **lay aside our thick warm cloaks** in summer, because we do not require thick clothing then; but we **put them on again** when the cold weather returns.

Lesson II

USES OF CLOTHING

Articles required for illustration:—a clinical thermometer, the dolls of the preceding lesson, and pictures of the seal, the white bear, the Esquimaux, and the African or other tropical savages.

I. Clothing to keep us Warm

We are now going to learn something more about the uses of clothing. I told you in our last lesson that we are exactly like cats, dogs, sheep, rabbits, and birds, in one respect. What is that? **Our bodies are warm,** and so are theirs.

Why are they warm? Because they have **warm blood** flowing through them.

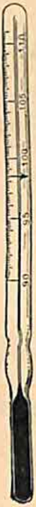
Very good; but what makes the blood warm? Perhaps you think it is the warm clothing that does it. Let us see.

Picture some poor hungry, starving dog in the streets. It stands whining and shivering with cold, in spite of its thick shaggy coat. That thick coat **cannot make it warm. It is cold because it is hungry.**

Then some kind person sees the dog, and gives it a good feed;

and after it has eaten the food, it no longer whines and shivers, but is soon warm and comfortable again. Food was the only thing that could have **made its body warm,** *and it is the same with those other animals, and also with ourselves.* **All the warmth in our bodies comes from the food we eat.**

Food **makes the body warm;** clothing **keeps it warm,** by preventing the warmth from passing away. We require sufficient food **to make the blood warm,** and proper clothing **to keep the warmth in,** or our bodies would soon grow cold, and we should fall ill, and most likely die.



Produce the thermometer. Explain simply that it is a curious little instrument, which is able to tell exactly **how warm anything is.** *The name should not be given now. Call attention to the thread of mercury in the tube, and without entering into any further description of the instrument for the present, place it in the mouth of one of the girls, and instruct her to keep it just under her tongue, and to close her mouth.*

Remove the instrument after a few minutes, and point out that the mercury **has risen in the tube.** *Call attention to the mark in the tube at the very point where the top of the mercury now stands. Explain that this mark is called* **blood-heat.** *Tell that it shows the exact heat of Mary's blood, and of course the exact heat of her body. No mention of degrees is necessary here. Explain that if either of the other girls tested the instrument in the same way, the mercury would still stand at the same point, because as long as people are well, their* **blood is always at one heat.** *Promise to let the girls test the instrument for themselves after the lesson.*

Explain, too, that this **blood-heat** *is the same both* **winter and summer,** *and that it does not alter* **whether we live in cold or hot lands.**

Show the picture of the seals. Describe the scene. Ice and snow throughout the greater part of the year. The sun never seen for months together. Yet the seals spend most of their time **swimming about in those icy seas.** *They live* *upon fish, and have to chase their prey through the water. Notice the peculiar form of the animals, and point out that* **they are made for swimming**—*they swim better than they can walk.*

Now look at this picture. Do you know the name of this animal? It is the **white bear**—a great fierce beast much larger than the seal. He too lives among the ice and snow in those cold frozen regions of the north.

This one has just come out of the water. What is that which he has in his mouth? It is **a seal.**

Explain that just as the seals **have to swim about in that icy water** *to catch the fish on which they live, so the bear has to swim about there too, for* **he catches the seals and eats them.**

Both the bear and the seal have **warm blood** like ourselves; they would die if their bodies got cold; and yet they are able to swim about among the ice without taking any harm. How is this?

Point to the **thick fur coats** *which cover their bodies. Tell that* **these coats keep in the heat,** *which their food makes, so that it cannot escape. These animals never feel the cold.*

Perhaps you would like to know something about the people who live in those same frozen regions, for there are people living there.

Show the picture of the **Esquimaux,** *and say a few words about their general appearance.*

They are not the kind of people we meet with every day, but uncouth and savage as they look, they are just like us in one respect. **They must keep up the warmth of their bodies,** or they could not live; and if we could put this little instrument into their mouths, **it would still mark blood-heat.**

How do they manage to keep warm in those icy regions?

The bears, seals, and other wild beasts that live there **make** and **keep** those people **warm**, for the men hunt and kill the animals, just as the animals hunt and kill one another. They eat the flesh of these animals for food, **to make themselves warm**, and they strip off their thick, warm fur coats, to make a covering for their own naked skins, **to keep the warmth in.** They could not live there without plenty of clothing, and rough as these skins of the animals look, they **keep them warm.**

II. CLOTHING TO KEEP US COOL

Show a picture of some of the natives of tropical Africa, and give a brief description of the climate in which they live. Not only are **ice and snow unknown** *there, but the sun shines with intense force directly overhead*—**it scorches like fire.**

In these hot lands the people do not want to keep in their bodily heat. They are glad to let it pass away. They do not require clothing **to keep them warm.** They could not wear even such clothes as we wear; they would die with the heat if they were clothed in those thick fur skins of the Esquimaux.

Their great trouble is to protect themselves as far as they can from the scorching rays of the sun—**to shut out the heat of the sun** from their bodies. Their dark, bronzed, sun-tanned skins show what the burning sun has done for them. The clothing worn in these hot lands is for the distinct purpose of **keeping the body cool.**

If we went to live there, we should clothe ourselves in the **thinnest** and **lightest of clothing.** Why? Because such clothing **lets out the heat of the body,** and **shuts off the heat of the sun. It keeps the body cool.**

Remind the children that if we used the instrument then to measure the heat of the body, it would show exactly the same **blood-heat,** *as it would in the mouth of the Esquimaux, wrapped up close in his thick furs.* **The clothing does it all.** *Lead the class to tell from this the reason why we make an entire change in our clothing to suit summer and winter.*

Why should we feel uncomfortable if we wore our thick winter clothing in the summer-time?

Why would it be very dangerous to go about in the winter-time with only our thin, light summer clothing?

III. Clothing to keep us from Injury

Remind the children that, besides keeping in the heat of the body, and shutting out the heat of the sun, clothing serves another purpose. It saves us from **cutting and bruising ourselves** *against things with which we come in contact.*

Which part of our clothing does more for us in this way than all the rest? **Our boots.**

Lead them to tell that the whole weight of the body rests upon the feet, but if the feet are well shod we have no fear of cutting or tearing them. We can run, jump, and skip about even on the roughest of roads without any danger. Stockings might keep our feet warm, but they would not keep out the wet, and nothing could keep us from injury like **our thick, solid boots and shoes.**

IV. Clothing to make us Decent

Tell that in the hot countries of the world, where clothing is less needed than it is with us, the children as a rule run about quite naked; but even there, as soon as they grow out of childhood, they wear a covering of some sort round the waist **for decency sake.**

In a climate like ours we wear clothing because we need it, and could not live without it, but even if it were not so, we should wear a covering of some kind **for the sake of modesty.** This then is another important use of clothing.

V. Clothing for Personal Adornment

Produce the dolls once more. Lead the girls to tell that the object of dressing the dolls was not to provide them with clothing, for the purpose of keeping them either warm or cool, because the dolls are not alive; and that for the same reason it was not meant to cover them up for the sake of decency.

What then was my object in dressing the dolls? **To make them look pretty.**

Exactly; and this will help you to remember that all our own clothing should in the same way **make us more attractive** and **more becoming,** as well as provide us with a suitable covering.

Elicit from the class that some of the things we wear, e.g. the bright-looking **ribbons, flowers, lace,** *and* **feathers** *in our hats and bonnets, as well as the* **pretty trimmings** *on our jackets and dresses, are* **for ornament entirely.** *They cannot keep us warm; they are simply* **to make us look nice.** *Clothing therefore is* **for ornament** *as well as use.*

I will close the lesson by showing you a picture of some of our dark-skinned sisters in far-off lands. They require (in those hot parts) very little clothing to keep up their bodily heat; they wear very little on the score of decency; but it seems as natural for them, in their way, **to try to appear gay and beautiful,** as it is to the women of civilised countries, for they deck themselves out with coloured beads, feathers, rings, and all sorts of finery, **merely for personal adornment.**

Lesson III

MATERIALS USED FOR CLOTHING

For illustration provide the pictures of the Esquimaux and the ancient Briton, some pieces of felt carpet, a felt hat, a rabbit's skin, some pieces of coarse flannel, a slate frame and some worsted, an old stocking and a darning-needle, specimens of textile materials and leather.

I. MAN'S FIRST CLOTHING

COMMENCE by showing once more the picture of the Esquimaux in their uncouth but warm-looking dress; and proceed as follows:—

Look at this picture, girls, and tell me where these half savage-looking people live. In the **frozen regions** of the North.

Where do they get that strange clothing from? They hunt and kill the seals and other wild animals that live there, and **strip off their skins** to make a warm covering for their own bodies.

Picture these people in their dreary northern home among the ice and snow. They are **not clever enough to make clothing materials** *such as we wear; indeed, they know nothing at all about manufactures, and* **there are no shops** *in which they can buy themselves clothes. This is why they have to depend upon the wild beasts around them for a covering. When any member of the family wants a new coat, father has to go out and* **fight one of these fierce creatures for its skin.**

Carry the children back in imagination to the early ages of the world, and tell that the people who lived then first learned to clothe themselves in the same way. **The very first clothes man wore** *in those far distant times were* **the rough, undressed skins** *of the animals he was able to kill.*

The Esquimaux are not the only people who still clothe themselves with the skins of animals. The people of Russia wrap themselves in **sheep-skins,** for their country too is bitterly cold throughout the greater part of the year.

It will interest the children to learn that the earliest known inhabitants of our own country had only the **rough, undressed skins of animals** *for their covering. Show a picture of an* **Ancient Briton,** *and explain that, if they read their history books, they will find that the people who lived here two thousand years ago were clothed like this.*

II. Felted Hair instead of Skins

Point out that to get the skins it was of course necessary to kill the animals. Tell that in course of time some one found out that hair might be easily **matted together** *into a kind of cloth, if it were wetted and then beaten with wooden hammers.*

Hand round the class for inspection some **pieces of felt carpet,** *and explain that this thick sort of cloth is made of hair matted together in that way. Show them that they can easily pull the hairs out of it. Tell that we call it* **felt,** *and we say that the hair of which it is made* **has been felted** *(or matted) together.*

This then is the kind of material which people in time learned to use for their clothing, **instead of killing animals for** the sake of **their skins.** But how were they able to get hair for this purpose without killing the animals?

Think what happens to the cat's coat in the hot summer weather, and you will be able to tell me this. **The hair falls out** as the weather gets warm, **because she does not want a thick coat then**; and remember, this is the case not only with the cat, but with all animals **that have thick coats.**

Tell of the sheep's habit of rubbing itself against the bushes when the warm weather comes round. Explain that the animal finds its thick coat **too warm and uncomfortable then,** *and this is the way in which it tries to get rid of some of it,*

by tearing it off in the bushes. *People who kept sheep in those early times must have noticed this, and it no doubt led them* **to cut off the wool every spring,** *for their own use to make that* **felted kind of material** *for their clothing. Sheep-shearing is far too ancient for any one to be able to say when it was first practised.*

We now use felt like this made of wool, for **carpets** and **table-covers,** but no doubt the material which those ancient people made for clothing was much coarser and rougher.

Do we use felt for clothing now? We wear **felt hats.** *Show one. Let the girls examine the material. Explain that this felt is made not of wool, but of* **rabbit's fur.** *We kill these animals for food, and we make use of their coats in this way. The fur is removed from the skin, and after being soaked in hot water is pressed and beaten till it becomes* **felted** *or* **matted together** *as we now see it.*

III. TEXTILE MATERIALS

Hand round the class some pieces of coarse flannel, the structure of which can be easily seen.

Call upon the girls to examine the material and tell how it is made. It consists of **two sets of threads** *which cross each other, and make a sort of* **web.** *Let them separate a thread or two from each set, and lay them on their desks for further inspection.*

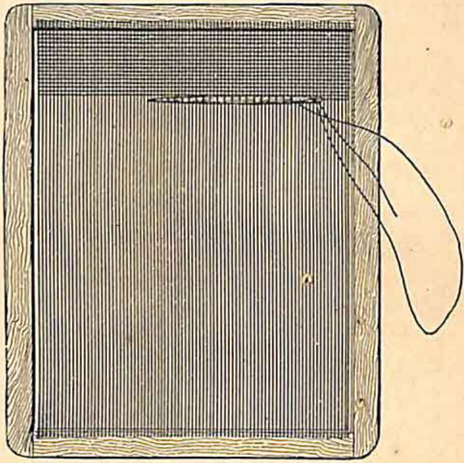
The arrangement of these threads in the piece of flannel may be illustrated in a simple way as follows:—Stretch some worsted tightly **across a slate frame** *from end to end, fixing the threads as close together as can be conveniently done by means of small brads or tacks. These will represent* **one set of the threads,** *and the other set may be interlaced crosswise with a needle, to form a web.*

N.B.—*The technical terms,* **warp and woof need not be given here.** *Indeed they would be best omitted altogether for the present.*

Explain that this process is called **weaving.** *Mother does something of the same sort in* **darning a stocking.**

Most of our materials for clothing are now made in this way by **weaving.** We call them **textile materials;** but the word **textile** is only another name for **woven. Textile materials** are **woven materials**—materials **made by weaving.**

Lead the children next to turn their attention to the threads



with which this woven material is made. They will easily find out for themselves that each thread is made up of **fine hairs twisted together.** *Set them to untwist the threads, and see that it is so.*

Explain that the wool is first **twisted up into threads,** *as we now see them, and then the threads are woven up into a sort of* **web or cloth,** *which we call* **flannel. All textile materials are made in this way.**

Without entering into any further description for the present, have specimens of familiar textile fabrics handed round the class for inspection.

IV. LEATHER

One more point before we close the lesson. We have not altogether given up the use of animals' skins for clothing. Indeed we wear some of these skins every day of our life. What do I mean? Our boots and shoes are made of **leather,** and **leather is made of the skins of animals.**

Lesson IV

SOURCES OF CLOTHING

The teacher should provide herself with specimens of familiar textile materials. It would be well to have one or two of the edges of these specimens ravelled out to show the threads. Provide also some raw wool, cotton wool, raw flax, raw silk, an old kid glove, a fur tippet, and a pair of scissors.

I. TEXTILE MATERIALS

SELECT four girls to stand out in front of the class, and proceed to call attention to some article of clothing worn by each, e.g., *Mary's* **serge frock,** *Jane's* **print pinafore,** *Annie's* **white collar,** *and Kate's pretty* **pink ribbon.**

Call upon the four girls themselves to examine these various articles and compare them one with another. Their **eyes will tell them** *that the materials of which these things are made are* **not at all alike in appearance,** *and* **if they touch them** *their fingers will tell them that they* **do not feel the same.**

Tell that the frock, pinafore, collar, and ribbon are really **made of different materials.** *We are going to see what we can learn about these materials now.*

Distribute the specimens round the class; instruct the chil-

dren to spread them out on the desks before them; and proceed as follows:—

Look at your pieces, and hold up the one most like Mary's frock. Now show me a piece of print like Jane's pinafore; now a piece of the white stuff like the collar; now, lastly, the piece of ribbon.

That is right. You have four different sorts of material in front of you. Now I want you to look at them all a little more closely. You notice that the edges of each of them are rough, where the material has been cut.

Why is this? They are **made of threads**; the rough edges are the ends of the threads.

Have each piece examined separately; and show that they are all alike in this respect.

What shall we say about all these things then? They are all **textile materials.**

What does that mean? It means that they are **made by weaving.** The **threads are woven** together.

Yes, if you look at the material, you can see in all of them the **threads crossing each other.** We could pull the stuff to pieces thread by thread.

1. **Wool.**—*Point out that as the four materials are all different, although they are made in the same way by weaving, we must look for a difference in the threads themselves, and then proceed to examine each specimen in succession, commencing with the serge.*

First pull the material to pieces, thread by thread, and then untwist the threads themselves. Call attention to the **curly, wavy nature of the fibres** *that make up the threads. Tell that this is* **wool.** *Show some* **raw wool,** *and ask where it came from. It* **grew on the sheep's back.**

Remind the children that this thick woolly coat is **to keep the sheep warm** *in the cold winter weather. The animal* **does not want its thick coat** *when the frost and snow are all gone, and* **so we cut it off** *to make clothing* **to keep ourselves warm.**

Lead them to name (as far as they are able) other materials made of wool. This need not be pressed too far, as it will be *dealt with in a later lesson.* **Blankets** *to keep us warm in bed,* **flannel** *to make warm underclothing,* **worsted stockings** *to keep our feet warm, and* **comforters** *and* **shawls** *to make warm wraps, to say nothing of materials for* **warm dresses, jackets, coats** *and* **cloaks,** *are all made of wool.*

We call this useful wool **an animal substance,** because it comes from the sheep.

2. **Cotton.**—*Proceed in a similar way to deal with the piece of print, first pulling the material to pieces, thread by thread, and afterwards untwisting the threads.*

This material is sometimes called **print,** and sometimes **calico print,** because pretty patterns are printed upon it, to make it into a nice material for **dresses, aprons,** and **pinafores.**

Did you ever see any other kind of calico? Yes, our **underclothing** is made of calico, and so are **the sheets on the bed.**

Is that print too? No, that is **quite white.**

Show some **cotton wool,** *and tell that this is the material of which calico is made. We call it* **cotton.**

What does this stuff look like? It **looks like wool.** *Compare with sheep's wool.* Yes, it is a sort of wool; we call it **cotton wool.** But it does not grow on the back of a sheep, or any other animal. It **grows on a tree or a plant.**

What name do we give to trees and plants of all sorts, that grow in the ground? We call them **vegetables.**

Yes, those things all belong to the **vegetable kingdom,** and so we say **cotton is a vegetable substance,** because it comes from a plant.

3. **Linen.**—*Follow up exactly the same treatment with the piece of linen. Show a bunch of* **raw flax.** *Tell its name—* **flax.** *It is the material from which the linen is made, and like cotton,* **it comes from a plant**—*the flax plant.* **Linen,** *therefore,* **is another vegetable substance.**

4. **Silk.**—*Deal lastly with the piece of ribbon in the same way, reducing the web to threads, the threads themselves to*

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separate fibres, and then comparing the fibres with a hank of raw silk.

Here we have a different sort of material altogether. It is **an animal substance,** because it comes from an animal; but **it never formed a warm coat for that animal,** as the wool did for the sheep. What can it be?

Point out the **thin delicate fibres** *of raw silk, and tell that this material was made for us by a* **sort of caterpillar.** *We call the material itself* **silk,** *and the little animal that makes it is* **the silk-worm.**

Now let us see what we have on the black-board. **Wool, cotton, flax** and **silk** are all used for making **textile materials. Wool** and **silk** are **animal substances; cotton** and **flax** are **vegetable substances.**

II. Leather

Show an old kid glove; let the children examine it for themselves.

Can you see threads crossing each other in this material? No. Cut it with the scissors, and see whether you can find the cut edges of any threads in it. No, the edges are quite smooth.

Can you pull threads out of it? No.

What can you tell me about this material then? It is **not a textile material,** because it is **not made of threads woven together.**

Right. It is made of **leather**; and I told you in our last lesson that leather is prepared from **the skins of animals.**

Then as all leather is made from the skins of animals, what kind of substance must we call it? An **animal substance.**

What else do we wear made of leather? Our **boots** and **shoes.**

III. Fur

Show a fur tippet—an old one would be best, in order that the skin side may be shown. Call attention to the **soft, smooth, glossy hair** *on the outside.*

What is this smooth glossy hair? It is the **warm soft coat** of some animal.

What do we call it? We call it **fur.**

Where does the fur grow? It grows **on the animal's skin.**

Turn the fur over now, and show that this sort of material consists of the soft thick smooth hair, and the skin in which it grew. **The skin** itself is now **like leather.** To get it, the animal had to be killed, and the skin stripped from its back. This then is another sort of **animal substance.** Remind the children once more of the Esquimaux and their clothing of fur skins.

Lesson V

CLOTHING MATERIALS—A COMPARISON

Provide the following articles for illustration:—Specimens of fur and leather, and the common textile fabrics, a sheet or two of blotting-paper, a jug of water, a square of leather tied up at the four corners into a sort of bag, a tin plate.

I. POROUS AND NON-POROUS MATERIALS

PRODUCE the specimens of fur, leather, and textile fabrics, and let the children name them one by one. Lead them also to arrange the specimens (1) as animal and vegetable products, and (2) as textiles and non-textiles.

What name may we give to all these articles? **Clothing materials.**

Why? Because they are the materials from which all our clothing is made.

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Lead the children to tell that some of our clothing is intended to **keep us warm in the winter,** *some* **to keep us cool in the summer,** *some* **to keep us dry,** *and so on. Explain that we are now going to learn how it is that each material is exactly fitted for its own particular purpose.*

Let us begin with leather—the material for our boots and shoes. The chief purpose of this part of our clothing is **to keep our feet dry and warm.** Why should we choose leather for this?

Call upon one of the girls to come to the front and pour a few drops of water on a piece of blotting-paper. Then let her hold up the blotting-paper, so that the class may see that **the water has spread** *all over the sheet.*

Remind them of their earlier lessons by folding up a piece of blotting-paper, as if for a filter, and filling it with water.

Why did the sheet of blotting-paper get wet all over? Because **blotting-paper is porous**; it **sucks up water.**

Can you think of a better word, instead of saying that it "sucks up" water? We can say **it absorbs water. Absorb** means **to suck up.**

What do we say about the blotting-paper, because it absorbs water? We say it is an **absorbent material.**

Now let each of the textile materials—flannel, calico, cloth, linen, and silk—be treated in exactly the same way. Call upon the class to explain that all these materials are **porous** *and* **absorbent,** *for they all* **absorb water.**

Lead them also to explain, from what they see, that all are not equally absorbent. Flannel is **the most absorbent of all**; *calico too is very absorbent; but silk* **takes longer** *than any of the others to soak up the water.*

Let them examine the materials again one by one, and they will see for themselves that **the looser the texture** *is* **the more absorbent** *it will be.*

Now let us turn our attention to the other clothing material—leather. Here is a piece of leather which has been standing in this plate of water for some time, but you see **the upper side of it is quite dry**—the water **has not soaked through.**

Here too I have a sort of leather bag which I made by tying the corners of a piece of leather together, and before the lesson began I filled the bag with water. The water is there still you see; **none of it has soaked through**; it has not even made the outside of the leather wet.

Now what shall we say about the leather? **It is not porous** or **absorbent.** It **does not let the water soak through.**

Exactly. We may say that **leather is water-proof;**[1] and it is because of this that leather is the best of all materials for keeping our feet dry in the wet weather.

Then as porous or absorbent materials would be useless as a covering for our feet, let us see why it is that they are so useful for the rest of our clothing.

Lead the children to tell in a simple way what happens when they run about and get very hot. The body becomes covered with moisture, which oozes out from the skin. We call it **sweat** *or* **perspiration.** *These absorbent materials* **soak up the perspiration,** *just as the blotting-paper soaked up the water.*

Explain that **flannel, worsted, and calico** *are the best of materials for underclothing because of this.* **Flannel** *should always be worn* **next to the skin,** *because it does not get cold and clammy when it is wet with perspiration, as calico does, and* **it saves us from catching cold.**

Tell further that our other clothing, being porous too, allows the moisture **to pass away** *from our bodies* **as vapour.**

Remind the children, on the other hand, that as our outer garments are made of one or other of these absorbent materials, they quickly get wetted in a shower of rain. We should **never sit about in our wet things,** *for that would give us cold.*

Lead them to tell that it is necessary to change our underclothing frequently, and why. It soon becomes **very dirty.**

What must be done with it then? It **must be washed.**

The laundress puts the articles into a tub of water;

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[1] This, although not so absolutely true, as it would be of india-rubber or gutta-percha, is sufficient for our present purpose.

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the water soaks into every part of them, **because they are porous**; and the dirt is easily washed away. She is able, when they are washed, **to squeeze the water out of them** by wringing them, just as we are able to squeeze the water **out of the pores of a sponge.**

II. Warm and Cool Materials

Place on the table pieces of fur, flannel, calico, silk and linen, and call upon one of the girls to lay her hand upon each in succession, and tell what she observes. She finds that the **fur, flannel,** *and* **silk feel warm** *to the touch—the fur warmer than the other two; that* **the linen** *feels* **positively cold** *compared with them; and that* **the calico also feels cold,** *but not so cold as the linen.*

Instruct her next to pick up the tin plate, which has been lying in front of the fire, and place it against one cheek, while she holds the fur against the other. Lead her to tell that, although both feel warm, the **warmth from the fur is not the same as that from the plate.**

Explain that the plate itself **is really warm**—*the fire has made it warm—but* **the fur is not warmer in itself than other things.**

When we lay our hand on the fur, **it does not allow the heat of the hand to pass away,** and that is why it feels warm. Woollen and silk materials feel warm for the same reason; **they prevent the warmth of the body from escaping.**

Call attention to the fact that all these are **animal substances.** *These materials make warm clothing* **because they keep in the heat of the body.**

The linen and the calico on the contrary feel cold, because as soon as they touch the skin **they rob the blood of its heat,** and it is this loss of heat from the blood that makes these materials feel cold. **Linen takes away more heat than calico,** and so it feels colder than calico.

Note that linen and calico are both **vegetable substances.**

They make **cool materials** *for wear in the hot summer weather, because* **they allow some of the bodily heat to escape.**

N.B.—*There need be no mention of conductors and non-conductors at this stage.*

III. Inflammable Materials

The lesson should not end without comparing the behaviour of the various materials if brought near a flame. This of course should be done experimentally so that the children may see for themselves. All burn; but while cotton and linen materials **blaze up instantly,** *the others burn less fiercely. Wool and leather* **simply frizzle in the flame.** *Speaking generally the vegetable materials* **catch fire more rapidly, and burn much more fiercely** *than the animal materials.*

Close with some practical warnings against the dangers of playing with the fire.

Lesson VI

WOOL

Articles required for illustration: some raw wool, specimens of linen, fur, and cloth, a pair of shears, a worsted stocking, and if possible, specimens of short-staple and long-staple wool.

I. Introduction

Produce the raw wool, and commence by leading the children to tell that this is the material from which our warm winter clothing is made. Call upon them to name articles of their own clothing which are made of wool.

Why should wool make warmer clothing than cotton or linen? Because **it does not allow the heat of the body to pass away.**

Let one of the girls come to the front, and place one hand on the wool, and the other on a piece of linen, and then help her to *tell what she observes. The* **wool feels warm,** *the linen cold. Why?*

Pass the wool round the class for further inspection, and lead the children to discover its other properties. It is **light, soft to the touch,** *and* **very flexible.** *Proceed to show in some such way as follows, the advantages of these properties in a clothing material:—*

1. Heavy clothing would tire us, and make us unfit for work. **Wool being light** provides us with a thick warm covering, such as **we can wear with ease.**

2. Wool makes the best of clothing to wear next to the skin, because it is a warm material; but it would not do for this purpose if it were harsh and rough. Its **softness makes it very suitable; it does not irritate the skin,** as some materials would.

3. Although the clothing should fit the body, it ought not to interfere in any way with our freedom of movement. A stiff material would do this, but **wool is flexible,** and so **yields** to all our movements.

II. HOW THE WOOL IS OBTAINED

1. **From the live sheep.**—*Show the piece of fur, and lead the children to tell that this was once the* **warm coat of some animal,** *and that in order to get the fur it was necessary to* **kill the animal.** *Remind them that this wool was also once the warm coat of a sheep, but* **it was cut off while the animal was alive,** *without hurting it any more than it hurts us to have our hair cut. It was the sheep's winter blanket to keep it warm during the frost and snow, but it did not want its thick covering when the cold weather was all gone. The wool* **began to fall off** *as soon as spring returned, and instead of leaving it to fall off, the farmer* **cut it off.**

Explain that it really does the sheep good to lose its thick coat during the warm weather, and as **the wool begins to grow again** *directly it is cut, the animal is sure of a new warm covering,* **as thick and long as ever** *by the time winter comes round once more.*

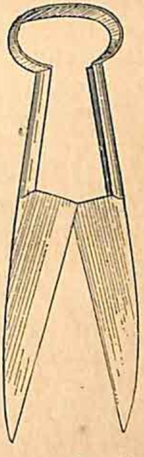
In this way, the sheep, without any injury to itself, gives us its wool for our own use year after year, as regularly as the spring returns. Men cut off the wool with great scissors or **shears**, and we call this **shearing the sheep.** Let me tell you how it is done.

Picture the sheep lying about in the meadows all through the winter. Their thick woolly coats get very dirty. The first thing to be done is to give them a good washing.

They are taken down to a clear running stream, and the shepherd and his dog drive them one by one into the water, where men stand ready to wash them. When the washing is over, the men let them go, and they scramble up the bank, and are free to roam about in the green fields again, and dry themselves in the warm sun.

A day or two later **the shearing begins.**

Show a pair of shears, if possible; if not, illustrate by means of a sketch on the black-board. Show how they are used, and explain that the shearer always sets about his work in one way.



He commences with the head and neck, and when the wool has all been removed down to the shoulders, he proceeds to cut away that on the under part of the body, leaving the sides and back of the animal to the last.

Picture the timid sheep all this while, and point out that it is no easy matter to hold the animal still and shear off the wool at the same time.

The **wool** which is cut **from one sheep** is called **a fleece.** Each fleece is rolled up separately, and the whole of the wool is then ready to be packed and sent away to the **wool merchant.**

2. **From sheep killed for food.**—*Remind the children that in this country sheep are reared mostly for* **food.** *What an immense number of sheep must be killed every year* **to provide all the mutton** *that is sold in the butchers' shops.*

Town children often see **carts loaded with sheep-**

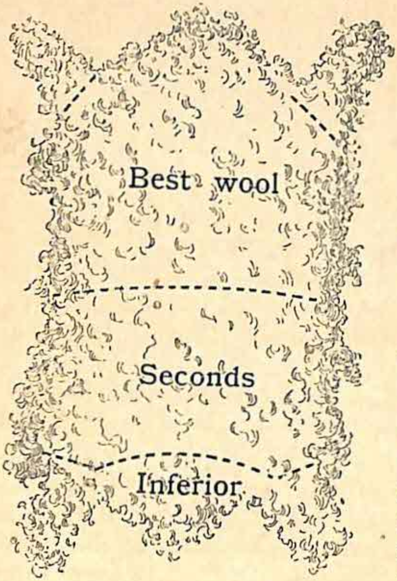
skins. *Remind the girls of this; and proceed to explain what is done with these skins.*

The butcher removes the skins from the sheep as they are killed, and sends them away from the slaughter-house **to the fell-monger's yard.** The fell-monger then selects **the best of the skins** to make **wool rugs** and **mats,** and he separates the wool from the rest of them, and sells it to the wool merchant, to be made up into **materials for our use.**

Explain that the wool taken in this way from the skin of the slaughtered animal is known as **dead wool**; *that which is obtained year after year by shearing the living sheep is called* **fleece wool.**

III. Sorting and Washing the Wool

Pass on next to consider the nature and habits of the sheep. The animal lies about so much on the damp ground, that the wool on the under parts of the body **must get matted together,** *and* **torn,** *and* **dirty.** *We should not expect to find the wool there as good in quality as it is on the back and sides.*



Make a sketch of the fleece on the black-board, and point out that there is actually very considerable difference in the quality of the wool on different parts of the body. **The finest wool** *is that on the* **breast** *and* **back**; **the least valuable** *that which grows on* **the under parts** *and* **near the tail.**

This will naturally lead up to a simple description of the first step in the process of manufacture—that of **sorting the wool.**

The sorter unrolls the fleeces one by one, spreads them out on the table before him, and **cuts them up** into portions according to the quality, taking care to keep the different qualities in separate heaps because each one has its own particular use.

Call attention once more to the sample of raw wool. It is **very dirty** *and* **very greasy.** *The wash which the sheep had in the stream before shearing could only remove the worst of the dirt, and nothing can be done with the wool at the mill, until it is quite clean.*

How does mother remove the dirt and grease from the soiled clothes on washing day? She washes them in hot water with soap and soda.

Tell that this is exactly what is done with the dirty greasy wool after it is sorted. It is thrown into hot water with plenty of soap and soda to get rid of the grease and dirt, and when this is all dissolved out, the wool is first rinsed in clear water, and then dried by pressing it between heavy rollers.

IV. DIFFERENT KINDS OF WOOL

Show some specimens of cloth, side by side with a worsted stocking, a comforter, or some such article. All these are made of wool, but the wool of the stocking **would not make cloth,** *neither would that which was used for the cloth make* **material for stockings.**

If specimens of the skins of the South Down and Leicestershire sheep can be obtained they should be shown. If not, pictures of the two animals must suffice. Tell that there is considerable difference in the nature of the wool from these two sheep. That from **the South Down sheep** *is* **short.** *It is known as* **short-staple wool.** *This is the wool which is used* **for making cloth.** *The fibres of the* **Leicestershire wool** *are* **much longer.** *This is known as* **long-staple**

wool, *and it is the material from which* **worsted goods** *are made. Promise to tell more of this in the next lesson.*

Lesson VII

WOOL AND HAIR COMPARED

Provide the following articles: specimens of cloth and worsted materials, some raw wool, a piece of fur; pictures of the Angora and Cashmere goat, and the Alpaca. If possible, specimens of the wool of each of these should be shown.

I. INTRODUCTION

SHOW the specimens of woollen cloth and worsted materials, and commence by leading the children to recapitulate a few important points from the teaching of the preceding lesson. Let the questions elicit in the first place that although both these materials are made of wool from the sheep, the kind of wool which was used for one would not make the other material.

This will lead them to tell that there are two different breeds of sheep—one with a close fleece of fine short wool, the other with a longer, more shaggy coat.

What names do we give to these different kinds of wool? We call one kind **short-staple wool,** the other, **long-staple wool.**

What does that mean? It means that in one kind the wool fibres are short, and in the other kind long.

How are these two sorts of wool used? The short-staple is made into **cloth**; the long-staple into **worsted materials.**

II. THE NATURE OF WOOL

I want to show you now why the short-staple wool is always used for making cloth, and the long-staple for making worsted goods; and to understand this properly we must examine the wool itself.

Place some wool fibres on a slate, side by side with some fibres of hair or fur, and let the children compare them one with the other. The first thing to strike them will be that the **wool fibres are curly,** *while* **the hairs** *are* **stiff and straight.**

Explain that this is the first important difference between wool and hair. **Wool is** *really* **a kind of hair,** *but it is much finer and softer than ordinary hair, and* **it is always curly—never stiff and straight.** *Let them next take one of the hairs, and draw it between the finger and thumb downwards from end to root, and then let them do the same with one of the wool fibres. What difference do they notice? The hair* **feels quite smooth and even** *from end to end; but the wool, although it is so fine, seems to catch as they draw it through the fingers,* **as though its edges were rough.** *Besides that, when they let it go,* **it springs back** *in a sort of cork-screw curl, but the hair remains almost as stiff and straight as ever.*

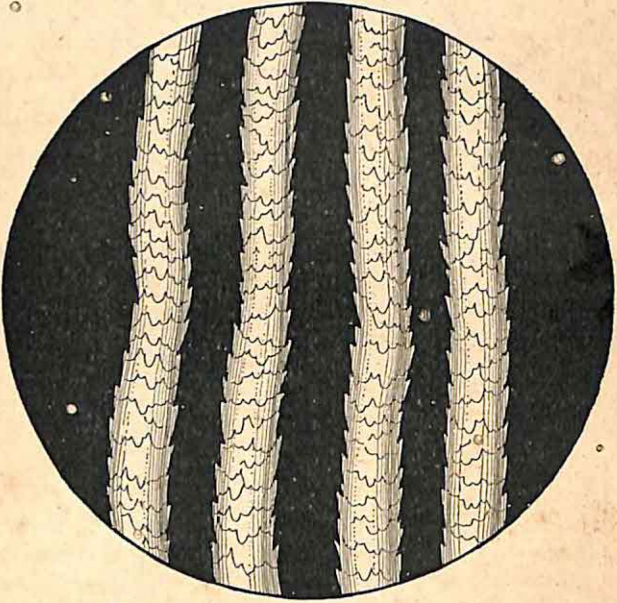
III. What the Microscope shows

If our eyes were sharp enough, we should be able to find out why it is that wool and hair are so different; but as we cannot see this for ourselves, I will show you a drawing of a fibre of wool, as it appears under the microscope.

Explain that the microscope is **a magnifying glass,** *which makes things look many times bigger than they really are. One of these fibres of wool, if we could look at it through the microscope, would appear* **like a thick rough cord.**

Tell the children that they must be content with a drawing of the wool fibre now, as it would take too long for all of them to look at it through the microscope; but promise to show it on another occasion, with the help of the instrument (if it is possible *to obtain one). Sketch the magnified fibre on the black-board and proceed to describe it.*

The drawing on the board looks like a thick rough cord, and all over the outside of it may be seen **a number of little points like the teeth of a saw.** These points are the ends of **tiny scales,** which overlap one another like the scales of a fish, and **all point towards the tip** of the fibre and away from the root. (*The scales of a fir-cone will give a rough idea of the arrangement.*) These scales are so small that they cannot possibly be seen with the naked eye; but it was their ends which made the wool fibre feel rough when we passed it through our fingers just now. **Hair has none of these projecting scales,** and so it feels smooth and even.



Call attention to the bundle of wool on the table. It is *tangled and matted together. Explain that this happens because the scales of one fibre cling to those of another.*

Tell that wool of all kinds has these scales, but they are more numerous in some sorts of wool than in others. The short-staple wool **has the greatest number of scales,** *and it becomes felted or matted together better than other wool. This explains why the* **short-staple wool** *is always used to make* **thick close cloth.**

The **long-staple wool has fewer scales;** *it will not make up into close thick cloth; but is used for* **stockings, flannels, stuffs, serges,** *and loose materials of that kind, such as girls and women wear. These are known as* **worsted goods.**

IV. OTHER WOOL

Children are so apt to think only of the sheep in connection with wool, that it will interest them to learn that in some countries goats and other animals are reared for their wool just as we rear sheep. Their fleeces are shorn every year, and the wool is sent to us to be made up into materials for clothing. Show pictures, and give a short description of each.

1. **The Angora Goat.**—This is the most important of

the wool-bearing goats. It is now reared in many parts of the world. **Angora wool** is **very fine, soft, and silky;** it is made into a material called **mohair.**

2. **The Cashmere Goat.**—This goat belongs to a country in Asia, called Thibet. It gives a **short, downy, silky wool,** which is made up into costly materials for clothing.

3. **The Alpaca** is a native of South America. Its fleece gives a very beautiful and useful kind of wool, which is more prized for making **stuffs and other worsted materials** than the wool of the sheep.

Lesson VIII

HOW WOOL IS MANUFACTURED

The teacher should provide herself with some raw and scoured wool, and specimens of the various fabrics mentioned in the lesson, a strong iron comb, a ball of darning worsted, a picture of the spinning-wheel, a slate frame, or the darning demonstration frame.

I. INTRODUCTION

COMMENCE with a brief recapitulation, dealing with the different varieties of wool, which have been mentioned in the foregoing lessons. Lead the children to tell (1) *that there are many different qualities of wool* **in the same fleece**; (2) *that the fleeces from two sheep may be totally different, one being the* **short-staple,** *the other the* **long-staple variety**; *and* (3) *that in addition to sheep's wool we use wool from other animals, such as the* **alpaca** *and the* **goat.**

Explain that each of these different varieties of wool is useful in its own way.

Call upon the children to enumerate, as far as they are able, materials made of wool, e.g. **flannel, blankets, serges, stuffs, cloth, carpets, gloves, stockings, shawls, vests, jerseys**—*and point out that although these things are all made of wool, the wool used for one material is* **very different from that used for another.**

Explain that the wool from our own English sheep is not suitable for all purposes, as it is **harsh** *and* **coarse** *compared with that which we get from some foreign countries. It is very useful for making* **coarse kinds of cloth, blankets, flannel,** *and* **worsted goods**; *but even the best English wool must be mixed with some of the soft, silky wool from Germany and Australia, to make* **broad-cloth** *and* **other smooth, glossy materials.**

In many parts of the world the people dislike mutton, and none but the very poorest ever touch it. They rear sheep, but **only for their wool.** Every care and attention is given to the **cultivation of the fleece,** and that is why the wool is so much better than it is in this country, where sheep are bred and reared **almost entirely for the butcher.**

In Germany the sheep are housed in stables every night, and even during the day-time they are carefully protected against the rain. From time to time they are washed, **sometimes with warm water and soap,** and the fleece is shorn every spring. They are kept for **ten or twelve years,** and of course when at last they are killed, the flesh is old and tough, and this no doubt accounts for the general dislike for mutton. **The wool,** however, from these sheep **is highly prized.**

This cultivation of the sheep's fleece will find ready appreciation among the girls, if their own hair is taken in comparison. Select some child with beautiful hair. One glance is sufficient to tell how carefully her mother tends it. She, by her constant care and attention, is **cultivating her child's hair.** *What would this same beautiful hair be like, without that mother's care? Picture some of the poor, neglected, shock-headed children that are to be met with in the poorer quarters of any large town.*

Show next, side by side with the raw wool, specimens of the different fabrics mentioned above, and tell that our next business will be to learn what has to be done to the raw wool to change it into these useful materials. We are going to learn how the wool is manufactured.

II. MANUFACTURE

1. **Combing the wool.**—*Produce the specimen of scoured wool, and without saying anything about it, let the children compare it with the raw material on the table. They will at once see that it is* **cleaner and whiter** *than that, and if they take it in their hands, they will find* **it is no longer greasy**

and sticky *to the touch as that is. They will have no difficulty in telling what has happened to it. This is the wool as it leaves the scouring house.*

Explain that in this state it is known as **scoured wool,** *and is now ready for the manufacturer.*

Point out that although the wool looks cleaner and whiter, **it is in a tangled mass.** *It must be got out of this tangle; the* **matted fibres must be separated** *in some way, and made to lie evenly, before anything can be done with them.*

What would be a good way to do this? **To comb the wool** with a comb, just as we comb our hair.

Tell that in old times people used to comb the wool in this way with iron combs. The comb was fixed in an upright position on a post, and the comber took the wool by the handful and drew it repeatedly between the spikes.

Illustrate the process by drawing some tangled wool or tow through a strong comb, so that the fibres are made to lie straight and even, side by side. Describe the modern combing machine.

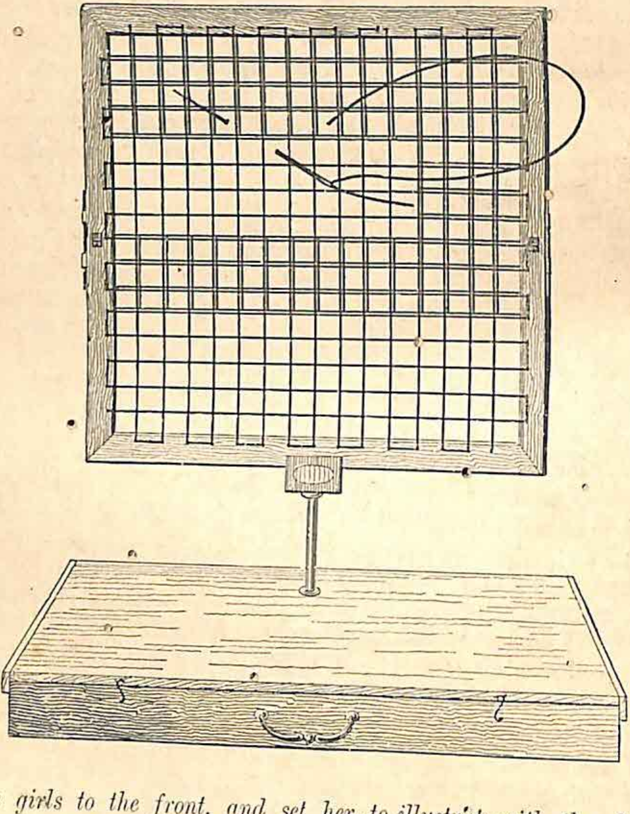
The combing machine is exactly like **a pair of immense drums.** They are made of leather, with **sharp steel spikes** set close all over them. The drums are placed side by side, and are made to turn round very rapidly, and as they turn, **the steel teeth** in them **comb the wool,** and so break up the tangled knots, and leave the wool-fibres lying smooth and straight

2. **Spinning the yarn.**—*Give the children once more some pieces of flannel or other worsted material, and instruct them to pull out one of the threads for examination. Let them untwist the thread itself and compare it with a ball of darning worsted.*

Both are made up of a great many wool-fibres **twisted together.** This twisting of the fibres into threads is called **spinning,** and the thread itself is known as **yarn.**

Explain that the spinning is all done by immense machines now, but it used to be done by the **spinning-wheel.** *Show a picture of the old* **spinning-wheel.** *Tell that in the olden times the farmer's wife and daughters used to spin the wool* *from their own sheep, and send the yarn to be made up into materials for use.*

3. **Weaving.**—*Refer the children to the piece of flannel once more, and let them point out that the material is composed of two sets of threads, which cross each other. Bring one of the girls to the front, and set her to illustrate with the slate frame (as the teacher did in the earlier lesson) the principle on which this material is made.*



N.B.—*In most schools there will be* **a darning demonstration frame,** *and this, of course, would serve* **to illustrate**

the weaving process *even better than the extemporised slate-frame.*

As she passes the **woof-thread** *backwards and forwards, point out that she does not break it off each time, but brings it back in a little loop. This gives the web* **an edge of its own,** *so that it will not ravel out. We call this the* **selvage,** *or* **selvedge**; *but the words only mean* **self-edge.** *Show the selvage on a piece of flannel or some other material.*

What do we call this work of making the yarn into a web? We call it **weaving.**

What name do we give to all materials that are made by weaving the yarn together? **Woven goods,** or **textile goods.**

Explain that in the factories the weaving is done by great machines called **looms.**

Lesson IX

MATERIALS MADE OF WOOL

Provide for illustration specimens of broad-cloth, kerseymere, melton, beaver, pilot-cloth, flannel, serge, and stuff, a teazle-head, a few articles of hosiery.

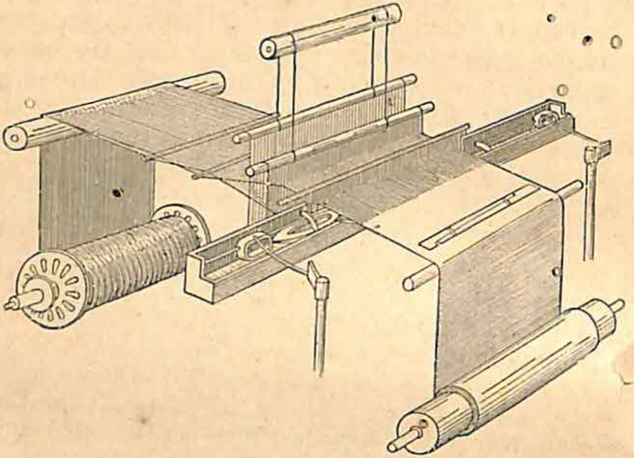
I. THE LOOM AND WEAVING

WHAT do we call the machine in which the yarn is woven into textile materials? A **loom.**

We will now try to learn something about this machine and the way in which it does its work.

N.B.—*The mechanism of the loom itself is of course too intricate for children to comprehend, nor is it necessary that they should do so; but they may easily be led to form a very clear notion of the principles involved by means of a sketch on the black-board.*

Commence the description by calling attention to the **two rollers** *at the* **opposite ends** *of the loom, with the yarn* *arranged round them, thread by thread, close together, and stretching from one end of the machine to the other. Notice that this is like the arrangement of* **the threads of worsted on the darning-frame.** *Tell that the weaver calls these threads* **the warp.**



Notice the **shuttle** *next. Compare it with the shuttle of a sewing-machine. It carries the other thread, which is to cross the threads of the warp. The weaver calls this thread* **the woof.**

Remind the children that when we did our weaving on the frame, we had to pass the woof under one thread of the warp, and over the next continually, and then proceed to show how this is accomplished in the loom by means of **the heddle.**

This contrivance is in two parts, and each part is attached to alternate threads of the warp. In this way, when the machine is at work, one set of these threads are **raised,** while the other set are **lowered,** and thus the **shuttle with its woof thread is able to pass between them,** and so a web is made.

Explain that in the old hand-looms the weaver himself sat in front of the machine, and passed the shuttle from hand to hand between the warp threads; but in **the great power looms** *of to-day* **steam does it all.**

The rollers revolve slowly, so that the warp threads may be gradually unwound from the hinder one as the cloth is made; the **two parts of the heddle** move alternately **up and down** at a rapid rate; and even the **shuttle is made to travel to and fro,** at the same rate, in a groove of its own, without the hands of the weaver touching it.

II. Worsted and Woollen Goods

Show now some specimens of **felted cloth** *side by side with the pieces of* **flannel, serge,** *and* **stuff,** *and lead the children to point out the difference between the two kinds of material.*

In the latter class of material the **threads of the warp and woof** can be distinctly seen **crossing each other,** but not in the former. Wool is the material of which all are made, but the wool which is used for one kind of material would not make the other.

Flannels, stuffs, and **serges,** and all goods of that kind, in which the threads of the warp and woof can be seen, are known as **worsted materials.**

Explain that they got this name because they were first made at the little Norfolk village of **Worsted,** *hundreds of years ago, by some Flemish weavers, who had been driven out of their own country and settled there.*

These worsted goods are made of the **long-staple wool,** or as the work-people call it, **combing wool.** It is so called because this is really **the only wool which is combed.**

What name did we give to the other variety of wool? **Short-staple wool.**

What is the great difference between the two? The short-staple wool is **much more wavy** than the long-staple, and **contains more scales.**

How would you know one from the other? The short-staple wool **easily gets matted together.**

Why is this? Because **the scales catch** one in the other and cling together. There are **fewer scales in the long-staple wool,** and that is why it does not get matted or felted together.

Now show the specimens of **broad-cloth** *and* **kerseymere** *once more.*

Lead the children to tell that, not only are we unable to see the threads crossing each other as in the worsted goods, but the material looks **as if it were felted.** *Tell that this is really the case; these materials are a sort of felt, and they are made of short-staple wool,* **because of its felting properties.**

Explain that, just as the work-people call one kind of wool combing wool, so they have a special name for this kind because it is not combed. They call it **carding wool.**

The carding process itself, however, need not be dwelt upon here. It will suffice to explain that the carding answers the same purpose as combing in **separating the wool-fibres,** *and making them ready for spinning into yarn.*

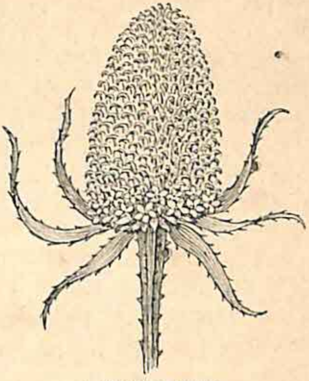
We call all goods made of short-staple wool **woollen materials** to distinguish them from the **worsted materials,** which are made of the long-staple wool.

When the worsted material leaves the loom, **it is ready for use**; but the woollen goods, although they too have to be spun into yarn, and woven in the loom, have afterwards to undergo another process of **fulling** or **felting.**

The piece of cloth as it is taken from the loom is put into a great tank with soap and water, and then **beaten with heavy hammers** for a long time. This causes the fibres **to felt together,** so that when the cloth is dried it is thicker than it was, and **the threads can no longer be seen crossing each other.**

After this, the surface of the cloth is brushed up by a machine with a brush made of **teazle-heads.** *Show a specimen of one if possible.*

These teazles are **a sort of thistle,** and they are covered with **little stiff hooks.** As the brushes turn



A TEAZLE-HEAD.

round; the little hooks catch in the short fibres on the surface of the cloth, and pull them up, so as to make them form **a nap all over the cloth.**

The nap is then cut even to give it a smooth surface, and nothing more has to be done but to press it between smooth rollers, and it is then ready for use.

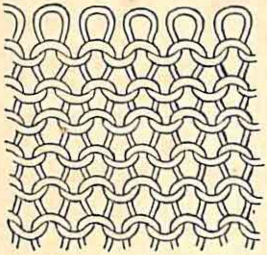
Broad-cloths, meltons, beavers, kerseymere, and **pilot-cloth** are all made in this way.

Kerseymere is the fine felted cloth which is used for livery clothing for gentlemen's servants.

III. KNITTED GOODS

Show some knitted article, e.g. *a* **woollen vest, a stocking,** *or* **a glove.**

Compare the texture of this with that of the woven goods. It is not made of warp and woof threads crossing each other, but of threads looped together **by knitting.**



We always use this kind of material for stockings. **Hose** is another name for **stockings.** That is why we call all articles made in this way **hosiery.**

Call upon the children to name as many of these articles as they can.

Lesson X

FUR

Articles required for illustration: some raw wool, pieces of sheep-skin and goat's-skin, a fur muff and tippet, a live cat, a few specimens of fur, a rabbit's skin undressed, a tin plate, and pictures of the fur animals.

I. INTRODUCTION (WOOL, HAIR, FUR)

THE purpose of this introduction is to make the now familiar wool a starting-point, and from it to proceed to discuss briefly the nature of the other coverings of mammals—hair and fur—to compare them one with another, and to show that all are modifications of the same thing.

Produce once more the specimen of raw wool, and commence as follows:—

This wool, as you know, once grew on the sheep's back. It was the animal's thick winter coat. What kind of animals require a thick coat? **Warm-blooded animals.**

Why is that? They must have thick coats **to keep them warm.**

How does the thick coat keep the animal warm? **It keeps the heat in the body,** and prevents it from passing away.

Do you know any other animal besides the sheep, which has wool for its covering?

The children will no doubt name the goat as a wool-bearing animal, and this will afford a good opportunity for reminding them that only a **few special kinds of goats,** *like those mentioned in Lesson VII.,* **have a fleece of wool.** *None of the common goats which we see in this country have wool for their covering.*

Show a picture of one of these common goats, side by side with the picture of the sheep, and lead the children to compare the coverings of the two animals.

The wool of the sheep's coat is **very fine, very curly, and very thick**; the material of the goat's coat is **long, straight, coarse hair.**

If a piece of the actual skin of each could be obtained, the children would learn more of the two things by handling them. Elicit from the class that **certain kinds of dogs** *have* **long, shaggy coats** *like that of the goat. Explain that we call this* **hair, not wool.** *Call upon the children to name other animals which have hair for their covering, some long and shaggy, some short and close. Assist of course where necessary.*

Now produce the cat, and let the children compare her coat with the wool of the sheep on one hand, and the hair of these latter animals on the other.

The cat's coat is **not wavy and curly** like wool, and it is much **finer, softer, thicker,** and **smoother** than ordinary hair. It is **neither wool, nor hair**; we call it **fur.**

Remind the children that these various coverings grow on the skins of the animals, just as the hair grows on our head. We give them different names,—**wool, hair, fur**—*because of their different appearance and properties.*

II. PROPERTIES OF FUR

How is wool used as a material for clothing? It is twisted or spun into yarn, and the yarn is woven into cloth.

What name do we give to materials made in this way? We call them **textile** or **woven goods.**

Hand the muff and tippet round the class for inspection, and lead the children to tell that these articles were not made by weaving.

Compare them with the cat's coat, and point out that they are made of fur, and that the fur looks exactly as it does on the animal's back.

Tell that hair and fur are not made into textile materials for clothing.

The fur animals give us their coats only once, and that is **after they are dead.** *We never shear the fur from the living animal as we shear the wool from the sheep.*

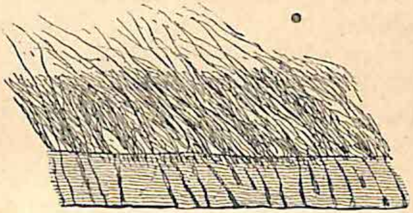
Pass the specimens of fur round the class, and elicit from the children that each piece consists not only of the soft, smooth, glossy hair like that on the outside of the muff and the tippet, but also of **the actual skin of the animal.** *Remind them that in order to get the fur, it was necessary, in every case, to kill the animal and strip off its skin.*

Let them examine the skin side first. They will find that it is **stout and thick like leather,** *and it is* **tough and strong,** *for* **it will not easily tear** *if they pull it.*

Show the undressed rabbit's skin, and point out that in this case the skin itself is very stiff and hard, and it **easily cracks and tears** *if it is pulled. Explain that when the skins are stripped off, they have to be properly prepared, and this makes them* **soft, tough, and pliant.** *Promise to tell in a later lesson how this is done.*

Now let us examine the cat's fur once more, and see what we can learn about the hairy outside part. The first thing to notice is that it is really **a double coat,** for there are two kinds of hair growing side by side. The under coat consists of **very fine, short, soft, silky hair,** slightly inclined to curl; and the microscope would show that each hair is barbed with projecting scales. This is **the real fur.** It grows very thick and close on the skin, and makes a warm under-vest. The hairs of the outer covering are **long, straight, stiff,** and **perfectly smooth,** owing to the absence of projecting scales. This top-coat is known as **the over-hair.**

Point out both kinds of hair in the coat of the cat. Explain that in the living animal the long stiff hairs of the over-hair perform an important duty in helping **to keep the fur somewhat loose,** *and so prevent it from matting together.*



Tell that the most costly furs **owe their elegance and value** *chiefly to the length and fineness of this over-hair.*

Repeat the illustration given in Lesson V. with the warm tin plate and the piece of fur. Both feel warm when the hand is laid upon them. Call on the children this time to explain the nature of the warmth in each case.

N.B.—*This must be done, for the present, without any reference to "good and bad conductors." The plate is really warm from the heat it has received from the fire, but* **the fur is not in itself warmer than other things.** *Why then does it feel warm?*

III. Fur Animals

Lead the children next to think about the animals on the farm. Picture the sheep lying out in the fields, night and day, through all weathers.

Explain that the farmer does not leave his cows and horses out in the cold like this. He puts them in warm sheds and stables when the winter comes. Why is this?

The thin coats of hair which cover the cow and the horse would not be sufficient protection for these animals in the bitter winter-time; but the thick fleece of wool is able to keep the sheep warm, in spite of the cold all around. **It keeps the warmth of their bodies from passing away, and also keeps the cold biting air off from their bodies.**

Remind the children that in some parts of the world it is very much colder than it is here, and even a fleece of wool would not be warm enough for the animals that live in those lands. These animals are always clothed in **a thick fur coat,** *because it is* **the warmest of all coverings.**

Among the fur animals are **squirrels, hares, rabbits, bears, foxes** (black, red, blue, and silver), the **sable, ermine, skunk, racoon, sea-otter,** and **seal.**

Show pictures of these animals, point them out one by one, and promise to tell more about them in the next lesson. Explain that they are all **wild animals,** *and that many millions of them are killed every year for the sake of their beautiful warm coats of fur.*

Lesson XI

SOURCES OF FUR

Provide for illustration specimens of as many varieties of fur as can be obtained, and pictures of the fur animals.

I. FUR ANIMALS

PRODUCE the picture of the fur-bearing animals, and commence with a brief description of each as follows:—

Which of all these animals is best known to English children? The rabbit.

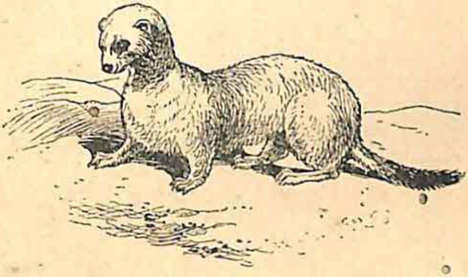
Yes, **rabbits and hares** are **the commonest of all our wild animals.** The farmer shoots them whenever he finds them in his fields, because they eat up his crops. Their flesh makes good food, and their skins provide us with useful furs.

Tell that in Australia the land is so overrun with rabbits, that they are a great trouble to the farmers, who kill millions of them every year, and send their skins to this country.

There is another little animal in the picture which some of you must have seen. It is a pretty little creature; it lives in the trees, and feeds upon nuts and acorns. What is its name? The **squirrel.**

Let the children point it out. Call attention to the **beautiful bushy tail.** *Tell that the fur of the squirrel is* **very soft and fine.** *It is made into* **boas and tippets,** *and is also used* **to line cloaks and mantles.** *If a specimen of the fur can be obtained, hand it round the class for inspection. Many millions of these little animals are killed every year for the sake of their beautiful fur coats.*

Call attention next to the **ermine** *and* **sable.** *Notice that they are very much alike in appearance. They belong to the same family. They are* **small animals,** *not half so large as a rabbit; but they are* **fierce and cruel,** *and they kill and eat animals much larger than themselves. Their* **fur is highly prized.**



THE ERMINE.

It will interest the children to learn the curious fact that these animals **change their colour** *as winter comes on. Tell that the fur which we call* **ermine** *is* **snowy white.** *If possible show a specimen.*

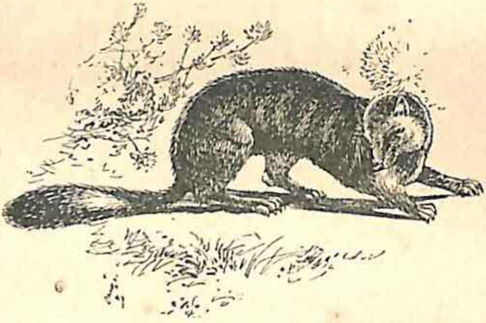
This beautiful white fur is only **the winter coat** of the animal. Its fur **is brown in summer,** and we then call the animal **a stoat,** not an ermine; but it always **changes to pure white** as winter approaches.

The most curious thing of all is that **the beautiful black tail** does not change colour with the rest of the fur, but remains as black as jet all the winter.

Explain that for ages **ermine** *has been used for* **the costly robes of kings and queens,** *the great officers of state, and the nobility of the land.*

None but the nobles were allowed to wear ermine; and the rank of the wearer was known **by the number of these black tails** *in the robe, and the way in which they were placed on the white fur.*

Sable is one of the most beautiful and costly of furs.



THE SABLE.

As we see it the fur is **a rich deep brown.** This is **its winter colour**; in the summer it is **almost red** and **spotted with grey.**

Explain that this change of colour is very common among the animals of the frozen regions of the North; but they usually change to white.

After a few days' exposure to the snow, on the return of winter, the fur becomes white, not because new white hairs grow, but **because every hair on the skin changes colour.**

Silver-fox, skunk, and **racoon** are very rich, beautiful furs, prized because of the length and fineness of the over-hair.

Call attention to the pictures of these animals. Tell that **a single skin of the silver-fox** *will sometimes fetch from* £20 *to* £25.

Notice next the **sea-otter.** *Call attention to the* **webbed feet.**

What kind of an animal would you expect this to be? **A swimming animal.**

Tell its name, and explain that otters are very curious animals, which live as much in the water as on land. They *are* **splendid swimmers,** *and feed on fish. Without these webbed feet they would be unable to catch their food.*

THE SEA-OTTER.

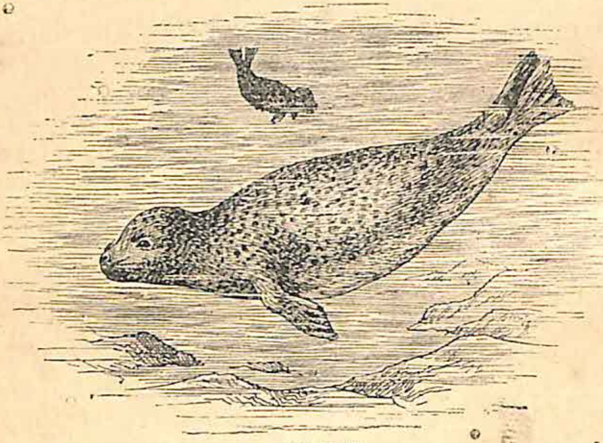
Explain that the common otter lives in and near rivers; but this one—**the sea-otter**—*makes its home on* **the wild rocky sea-shores** *of North America, far remote from man.*

The fur is **short, close, and thick,** but extremely fine, and as **soft as velvet.** A single skin of the sea-otter has been known to sell for as much as **£100.**

Lastly, call attention to **the seal.** *Point out that this animal has only a pair of* **short flippers** *in place of the ordinary limbs. They look more like* **the fins of a fish** *than legs. Lead the children to tell that it could not run, or even* *walk very quickly with these. Explain that this animal, like the otter,* **lives in the water** *as well as on land, but it is much more at home in the water than out of it.* **It spends most of its life in the water.**

The seal lives in the cold icy seas; it requires a thick coat **to keep it warm.**

The seal's skin is **a beautiful thick soft fur.** Immense numbers of seals are killed every year to provide fur for ladies' **jackets, mantles, muffs,** and other costly articles of clothing.



THE SEAL.

II. Fur Hunting

Remind the children that all **these fur animals,** *and many more which we have not named, are* **wild,** *and that their proper home is in the* **cold frozen regions** *of the world, almost unknown to man.*

Without entering into geographical details, point out Siberia and the north of North America on a map of the world, or a globe, and help the children to form a mind-picture of these wild inhospitable regions. Tell that these two parts of the world supply nearly all the furs we use. The fur animals live *there, and if we want their warm beautiful coats,* **some one must go there to get them.**

Picture **the bold intrepid hunters,** *who leave their homes every year for months together, to make their way into these dreary wilds in search of furs. During all this time they may not meet another person, and they are every moment* **exposed to risks and dangers,** *both from the unknown nature of the country, and also from the fierce wild beasts, which prowl about on every side. None but* **the hardiest and bravest men** *could face such dangers. Even while the hunter is lying in wait for one animal, some other fierce beast may be creeping noiselessly up to spring upon him.*

Now let us think once more of pussy at home. If you take her on your lap in the warm weather what happens? **Her fur comes out** and covers us with hairs. Some of the fur always falls off in the warm summer weather.

Do you notice the same thing in winter? No, because **the fur grows thick and close** again before the cold weather returns.

It is exactly the same with all the fur animals. Their coats always get thinner when the cold weather is gone, because the hairs at once begin to fall off; but **the fur grows thick and close** again before the frost and snow return.

Which do you think, then, would be **the best time of the year** for the hunters to go in search of the fur animals? The winter.

Explain that this is so. The fur coats, if taken from the animals at any other time, would be of little value, as the hair would easily fall out. The poor fur-hunter has to face **the terrors and hardships of those dreary northern winters,** *as well as the other dangers, or he would get nothing for his trouble.*

All through the winter he is busily engaged in the wildest, coldest, and most solitary parts of the world, **hunting, trapping, and shooting** these wild beasts, and collecting their furs. The skin, or **pelt** as it is called, is stripped from each animal as it is taken; and it is then

rubbed with salt to prevent it from rotting or putrefying. After the break-up of winter, they bring their collection to certain towns, where **fairs or markets** are held for the sale of the furs.

III. FUR FOR CLOTHING

Lead the children to see from what has been said that, although the Esquimaux can easily clothe himself from head to foot in furs, because he has only to kill the animal and strip off its skin to make himself a covering, the same kind of furs must be **very expensive** *by the time they reach us.*

In this country fur is much used as an **ornamental trimming** for winter clothing, but only well-to-do people can afford **real fur garments,** except such things as **muffs, capes, tippets** and **boas.**

People who have furs take great care of them because **they are costly.**

A careful housewife will never think of putting her furs away damp, for **damp will quickly make them go mouldy.** Should they get wet she hangs them **in a warm dry place** after shaking them well, and does not put them away till they are quite dry.

Before she puts them away for the summer, too, she first gives them **a smart beating with a cane,** and then wraps them up in **brown paper** with some **camphor.** She knows that **moths are very destructive to furs**; but as moths dislike camphor, her furs will be safe all the summer if she treats them in this way.

Lesson XII

PREPARATION OF THE FURS

Articles required: two rabbit skins (one properly prepared, the other undressed), specimens of fur, and a felt hat.

I. INTRODUCTION

COMMENCE by leading the children to think once more of the fur-hunters, the hardships they must undergo, and the dangers they must face during the long dreary northern winters in their search for furs. Why do they always choose the winter as their hunting time?

Picture the men busily engaged stripping off the skins of the animals one by one as they are taken. Tell that these skins, if left to themselves, would in time **rot and decay, the hair would fall off,** *they would become useless: and then elicit from the class that the men prevent them from rotting by rubbing the skin-side well with salt. Explain that the* **intense cold and the salt** *together preserve the skins all through the winter.*

What is done with them when the winter is over? The hunters take them into the towns **where the fur markets are held,** and sell them to the traders.

II. THE WORK OF THE FURRIER

Picture the furs as they are handed over by the hunters. The animals were hunted and killed, and most likely their bodies were not only dirty, but bleeding from their wounds when the skins were stripped off.

Before anything can be done with the skins they have to undergo several processes of **steeping, scouring,** and **cleansing**; and when this is over they are **salted,** packed close in great casks, and sent to England.

The man who dresses the furs, and makes them fit for use is called a **furrier.**

We should not think them worth much, if we could see them in their **greasy salted state** as he takes them out of the **pickle casks.**

He first stretches out the skin quite flat, with the flesh side uppermost, and pares away with a sharp knife all **loose pieces of fat and flesh,** which may have been left on it, when it was roughly stripped off the back of the animal by the hunter. These, if left on the skin, would cause it to rot and decay.

That done, the skin is steeped for some time in **a strong solution of alum and salt,** and this soaking changes the nature of it altogether. When it is taken out it is **thick and tough,** and it will never afterwards rot or putrefy as a fresh skin would.

It has to undergo another soaking in **bran and water** to get rid of the alum and salt, after which it is carefully dried, and rubbed on the flesh side with a liquid made of **wheaten flour** and **the yolk of egg.** This is necessary **to make the skin soft and supple,** for when it is first dried after its bran-and-water bath it is very harsh and stiff.

Show **a rabbit's skin** *which has been treated in this way, and compare it with the* **rough undressed skin,** *which was used in one of the former lessons. The children have only to handle the two, to observe the difference in the feel of them. The one is* **soft and supple to the touch,** *but the other is hard and stiff, and yet at the same time so brittle that it will readily tear, if it is pulled.*

The alum, salt, and bran have preserved the skin; the flour and yolk of egg have done the rest. But the most important change wrought by the alum and salt cannot be learned in this way.

Tell that the undressed skin if left in a damp place would rapidly begin to decay and rot away; but the one which has been prepared with alum and salt **is no longer subject to decay.** *It would last for many years.*

Show now as many specimens of furs as can be obtained, keeping back the piece of seal-skin for the present. Lead the children to point out **the double coat** *of* **fur** *and* **over-hair** *in each specimen where possible. Remind them that many* *varieties of fur owe their chief value to the* **beauty and fineness of this over-hair.** *Produce the piece of seal-skin next, and call upon the children to find the over-hair in that.* **It has no over-hair.**

Tell that the living seal, like other fur animals, **has a double coat.** *Its undercoat of real fur is close, soft, and smooth like velvet,* **the over-hair consists of long, strong, stiff hairs,** *which grow thick enough on the skin to almost cover up the real fur beneath.*

There is no long over-hair on the piece of seal-skin before us; it consists of **the real fur and nothing else.** Yet when the skin was taken from the animal, and put into the pickle-cask to be sent over to this country, it had stiff coarse over-hairs on it.

If we could see the coat of one of these living animals, we should wonder how it could be possible to change that **coarse, oily-looking, close-pressed hair** into the **rich, costly, seal-skin garments** which we see in the shops. Let me tell you how it is done.

In preparing the skin, the furrier stretches it out flat with the flesh side up, and shaves or pares off part of the surface with a sharp knife. In shaving off the under surface of the skin in this way, the **knife cuts through the roots of the long, stiff, over-hairs,** which are more deeply set than the rest, and it is then an easy matter to pull out all the long hairs, and so leave nothing but the soft, smooth under-fur.

Draw a black-board sketch of a section of the skin, showing the roots of the over-hairs.

Explain that all the furs, which are prepared by the furrier, as material for making muffs, tippets, boas and capes, and for trimmings for other articles of clothing, are known as **fancy furs,** *or* **dressed furs.**

The fur and skin in every case are used **as one material,** *the skin itself being changed by means of* **the alum, salt, and bran** *so that it will not rot or decay.*

III. FELTING FURS

Now think of what we said about the two kinds of fur on the cat's coat. The over-hair is longer and coarser than the fur beneath it; but do you remember any other difference between them? Each hair of the real fur **has projecting scales** on it, but **the over-hairs are quite smooth.**

Think of our lessons on wool, and tell me how these projecting scales act. They easily **catch one in the other,** and cling together.

What happens to the hairs if they are pressed together? They become **matted** or **felted together.**

Explain that, because of this felting property of the real fur, **hares' and rabbits' skins** *are largely used in making* **felt hats.** *The fur is removed from the skins for this purpose, but only the under part of it is of any use for felting. The over-hair has to be got rid of, and this is done in a very clever way by a machine called* **the blowing machine.** *The whole of the fur is put into this machine, in which the air is set in motion* **by means of fans.** *The wind blows the light, fine under-fur away, but the coarser heavier hairs fall by themselves, and so the two are separated.*

Lesson XIII

LEATHER

The teacher should provide herself with some specimens of fur and leather, a wool rug, a dog-skin glove, a thin strip of wood, a sharp knife, a piece of thin leather about twelve inches square, and the spirit-lamp.

I. INTRODUCTION

COMMENCE by referring once more to the work of preparing the skins of the fur animals with **alum and salt.** *Elicit by a few well-chosen questions* (1) *that it is* **the skin itself** (*not the fur*) **which is changed** *by the action of the alum and salt;* (2) *that the change* **preserves the skin,** *so that* **it**

will not afterwards rot and decay; *and* (3) *that the skin so changed is really* **strong tough leather.** *Show a piece of fur. The* **skin part** *of it is* **real leather.**

Remind the children next of the sheep-skins, which are stripped off the animals after they have been killed by the butcher. Lead them to tell that these skins are treated in a similar way, and **made into wool rugs,** *and that the under part of these rugs—the skin itself—***is changed into leather** *by the preparation.*

Elicit that some of these sheep-skins are not made into rugs. The wool is stripped from them and sent to the wool merchant. But what becomes of the bare skins, after the wool has been stripped off? They are steeped in a bath of alum and salt.

Show a stout kid glove and tell that this was once **the skin of a sheep**; *it was* **changed into leather by the action of alum and salt.**

Produce now the other specimens of leather. Notice that they are not all alike; some are thick, some thin. But they are all alike in one sense—they were **all prepared from the skins of animals.**

In the preparation of furs and rugs the skin is changed into leather **without removing the covering of hair or wool.**

In the preparation of real leather **the covering is removed in every case,** and only the skin itself is used.

II. Properties of Leather

*Hand a few of the pieces of leather round the class, and lead the children to tell, by holding them to the nose, that all have the same peculiar smell—***the smell of leather** *we might call it. We should know a piece of leather in the dark* **by its peculiar smell.**

What is the most important use we make of leather? We use it as the one material for our **boots and shoes.**

There are several reasons why leather is the best of all materials for this purpose. We will examine the pieces before us, and find out why it is so.

Take the pieces of leather in your hand and bend them. They all **bend easily**—even the thick pieces bend. What shall we say about leather, because it bends? **Leather is flexible.**

Look, I will take this piece of thick leather in one hand, and this strip of wood in the other. If I press them on the table, I can bend both of them—both then are **flexible.**

While doing it, contrive to press the wood enough to make it snap in two; and then show how the leather differs from the wood. It may be bent and twisted in any direction without breaking or even cracking. It is **very flexible.**

Elicit that the wood breaks because it is brittle; but **leather is not brittle**—*it is* **very tough.** *It holds well together; we cannot break, or snap it in two, and we cannot tear it by pulling it.* **It will bend, but not break.**

Show that it is also very difficult to cut this thick leather even with a sharp knife. It is **hard** *as well as* **tough**; *it will stand a great amount of* **rough usage** *before wearing out.*

What do we say about things that do not wear out quickly? We say they are **durable**; they last a long time.

Leather then is durable; it lasts a long time **because it is so tough and strong.**

Next let two of the girls hold the square piece of leather by the four corners, so as to make a sort of basin of it, and then fill the basin with water. Notice that the **water does not run through.** *Remind the children that water would easily run through flannel, serge, cloth, or any of the other textile materials. Why? Because they are porous.*

What shall we say then about leather, as water will not run through it? **Leather is not porous.**

This is another important property of leather. It is **not porous**; water will not soak through it. We say it is **water-tight,** or **water-proof,** or we may say it is **impervious to water.** All these mean the same thing.

Remind the children that the skin from which the leather is made was not impervious or water-proof. **It became so when it was changed into leather.**

Now let us think of all these properties of leather, and we shall soon see why it is that this material is more suitable than any other for making our boots and shoes.

Our boots have to **bear the weight of our body, to protect our feet** from injury on the rough stony roads, and to **keep them dry** in wet weather. Nothing but a **tough, strong, durable, water-proof** material would be fit for this.

Leather is tough, strong, durable and waterproof; but so are iron and wood. Why not use these materials for boots and shoes? **Iron would be too heavy,** and both would **hurt the feet,** because they are not flexible—**they would not bend.**

Think of some materials which are light and flexible. All the materials made of wool are **light and flexible.**

Then why not use some kind of cloth for boots and shoes? Because that material **would not be thick and stout enough to protect the feet** from injury; **it would soon wear out** on the rough hard stone; and **it is porous**—it would let in the water in wet weather.

Now tell me why leather is the best of all materials for covering and protecting the feet. It keeps the feet dry in wet weather, **because it is water-proof.** It protects the feet from injury, **because it is hard and tough.** It does not wear out quickly, **because it is very durable.** It does not hurt the feet, **because it is flexible,** and bends easily as we move about. It does not tire the feet, **because it is a light material.**

III. TAKE CARE OF YOUR BOOTS

Remind the children that **warm dry feet** *are very* **necessary to health.** *We cannot expect to keep well, if we allow our feet to get wet and cold. Our boots last a long time because* *leather is durable; but if we want our boots to keep out the wet*, **we must take care of them.**

What do we do with our boots if we get them wet? We stand them in front of the fire to dry.

Some people do, and I want you to think of that while you watch me. I will hold this piece of leather in the flame of the spirit-lamp, and you see that it at once **frizzles up and burns.** I will hold this other piece, not in the flame, but near it. Notice what happens. The leather **begins to shrivel up,** and get **hard and stiff.** When I take it away from the heat, it is so stiff **that it will easily crack.**

Now think of your wet boots, and tell me why I have shown you this. If we put our boots too close to the fire, **the heat will make the leather shrivel up** and get **hard and stiff,** and then it will **easily crack.** Be careful never to put wet boots too near the fire; but let them dry slowly.

Lesson XIV

SKINS AND LEATHER

Articles required for illustration: some specimens of the different kinds of leather mentioned in the lessons—a kid glove, a leather purse, a piece of wash-leather—a flesher and a skiver, a stout dog-skin glove, and an ordinary kid glove, a white kid glove, and some article made of morocco leather.

I. Nature of the Skin

You have already learned that the skins of various animals provide the material for making leather—that in fact every kind of leather is made from the skin of some animal. But in order to properly understand what leather is, and how it is made, we must know something about the nature of the skin itself.

N.B.—*The structure of the skin must be dealt with in a very simple way at this stage, without any reference to detail or technical terms, the only object being to prepare the way for a clear conception of the tanning and tawing processes of the manufacture.*

The first thing to remember is that **our own skin** (yours and mine) is practically **the same in structure** as the skins of all these animals. Therefore if we examine our own skin, that will tell us all we want to know about the skins which we use for leather.

Commence by pointing out that the skin all over the body appears, at first sight, to be merely a soft, smooth, close-fitting coat or covering. Tell that closer examination proves it to be something more than this. Pinch up a fold of the skin on the back of the hand with the finger and thumb, and call upon the children to do the same. Point out that this skin, whatever it may be, is **a very thin covering**; *and then tell that thin as it is, it can be easily* **separated into two distinct layers,** *or skins, one underlying the other.*

Explain that this is exactly what happens **when the skin is blistered** *through a burn or a scald. The top layer of the skin* **becomes separated from the lower one** *through the injury.*

No doubt you have all seen a blister of this sort. Tell me what it looked like. It was like **a white, puffed-up bladder,** and was **full of water.**

What did mother do to let the water out? She cut a small slit in the blister with a sharp pair of scissors.

Did it hurt you to have the blister cut? No, I did not feel it.

Explain that this top layer of the skin, which forms the blister in such cases, is **tough and horny.** *It is meant to protect the layer beneath it from injury.* **It does not feel pain; it does not bleed** *if is pricked or cut. Prove this by running a needle through the skin on the palm of the hand.*

Tell that beneath this outer layer lies a thicker and more important one—**the true skin.** *This is altogether different from* *the other. It is* **very tender**; *the slightest prick with a needle* **would cause pain** *and* **make it bleed.**

It is composed of a mass of fibres crossing each other in every direction, and the spaces between the fibres are filled up with a glue-like substance called **gelatine.**

Remind the children that the skins of all the animals which provide us with leather are in this respect exactly like our own. The skin of one animal may be very much thicker than that of another; but there are always the **same two layers—a tough horny one** *on the outside, and a more delicate one—* **the true skin**—*beneath it. Tell that it is the true skin in every case which* **provides the material for leather.**

The skins of some animals, such as the **ox, horse, buffalo,** and **antelope,** are very thick and heavy. They are called **hides,** and are made into the **heaviest, thickest kinds of leather.**

Show a piece of sole leather, and tell that this was made from the thick hide of a **full-grown bullock.**

Show next a **kid glove,** *a* **purse,** *a* **piece of wash-leather,** *or any article made of the thin, lighter sorts of leather.*

This too is leather; but it is not made from the same kind of skins, nor is it prepared in the same way. The goat, kid, sheep, and lamb, are the animals which provide the material for this kind of leather, and their coats are described by the simple name of **skins,** not hides.

II. LEATHER FROM SKINS

If a skin be taken from an animal and thrown aside in a damp place, it will soon begin to smell badly and decay, **because the gelatine** in it **has a strong tendency to putrefy and rot when it is wet.** But if the same skin were at once hung up in a dry place, it would shrink and become horny and stiff, because **the gelatine would dry and harden.**

Explain that in either case the skin would be useless. The work of preparation therefore is **to prevent the gelatine**

from putrefying and rotting *the skin on the one hand, and from making it* **hard, stiff, and horny** *on the other.*

1. **How the wool is removed.**—*Picture the sheep-skins as they are stripped from the sheep in the slaughter-houses, and taken away in cart-loads to the fell-monger. Elicit that as the skin only is wanted for leather, the first step must be to remove the wool from it.*

Remind the children on the other hand that the wool is as valuable as the skin itself. It must be removed from the skin without doing any damage to either. Tell how this is done.

The skins, after being thoroughly washed, to cleanse the wool from dirt, blood, and grease, **are hung up,** wet as they are, **in a warm room,** and there left for several days.

How would this be likely to act upon the skins? It would make them begin to **decay and rot.**

What part of the skin would you expect to begin to rot first? The **gelatine.**

Explain that this is exactly what does happen. The heat and moisture together **cause the gelatine to rot,** *and this makes the skin itself begin* **to swell up** *and* **thicken.** *In a short time it becomes* **covered with a sort of slime,** *which oozes out from it, and it* **smells very badly,** *as the decaying work goes on.*

The skin is then ready for the next step, and the wool may be easily pulled out in handfuls, **for it becomes loosened at the roots** *as the skin swells. It is taken down, and the wool is either removed in this way, or else scraped away with a blunt knife.*

The scraping-knife removes not only the wool **but the outer layer of the skin as well,** *for this too becomes loosened from the true skin, as the rotting and swelling go on.*

All **particles of fat and flesh** *too are removed from the skin during this scraping process, so that at last nothing is left but* **the true skin** *to be made into leather.*

2. **Tawing the skins.**—*Tell that the next step is to throw the skins into a* **bath of alum and salt,** *and leave them there to soak for some time. Remind the children that the skins have*

already begun to rot when they are thrown into this liquor. If they had been left to themselves, they **would have continued to rot and decay.** *The lessons on furs have made them familiar with the action of alum and salt. Let them now describe the effect of the treatment on these skins, the teacher of course assisting where necessary.*

(*a*) It at once **puts a stop to the rotting** of the skin.

(*b*) It so **changes the gelatine** that it can never rot again, and the skin is thus made **very durable.**

(*c*) It causes the skin to **swell up and thicken** very considerably, so that it becomes **stout and strong.**

(*d*) It makes the skin **impervious,** because as it swells and thickens **all its pores become filled up,** and it will no longer absorb water.

Explain that the meaning of all this is that the skins when taken out of the alum-and-salt bath are **real leather.** *Still as they dry they are found to be very stiff and brittle. They would be useless in that state. To make them* **supple and flexible,** *they have to undergo two more soakings—first in* **bran and water,** *and afterwards in a liquor made of* **wheaten flour and yolk of egg.**

III. VARIETIES OF THIN LEATHER

Produce the specimens of leather, and lead the children to examine them and compare them one with another.

Commence with the pieces of **roan** *and* **wash-leather.** *Call attention to* **the grain of the leather** *in the roan. Explain what it is, and show that the wash-leather* **has no such grain.** *How is this?*

Tell that both were originally sheep-skins, but that sometimes the skin **is split into two distinct skins** *before it is made into leather. This wash-leather is* **only the under layer,** *or* **flesher,** *of a split skin; hence it* **has no grain.** *Roan consists of the whole or* **unsplit skin.** *It makes a beautiful kind of leather which is much used in* **book-binding.**

Tell that the fleshers which are intended for **wash-leather** *are* **not tawed.** *They are first steeped in* **bran and water,** *after which they are* **sprinkled with oil,** *rolled up (four or five together) in a ball, and beaten with* **heavy wooden hammers.** *The oiling and hammering have to be repeated several times before the leather is fit for use. Explain that wash-leather is frequently called* **chamois** *(shamoy, shammy)* **leather.** *The reason is that it was formerly made from the* **skin of the chamois-goat,** *not from sheep-skins.*

Tell that the upper layer of the split skin is called **a skiver.** *This is* **tawed** *in the usual way, and is used for* **hat-linings** *and other purposes.*

The stout **dog-skin gloves** for men's wear are made from the skin of the **South African sheep**; and almost all the so-called kid gloves are made from **goat-skins** and **sheep-skins.** Only the very best kid gloves are actually made from kid-skins. This kind of leather is made from the unsplit skin; but military gloves are made from **sheep-skin fleshers.**

Lamb-skins are always **tawed unsplit,** as they are too thin to bear splitting. From them is made a soft white leather known as **beaver,** which is largely used for making the cheaper sorts of **white kid gloves.**

Goat-skins are chiefly used in the manufacture of **morocco leather,** but an inferior sort of morocco is made from **sheep-skins.** Morocco leather is very **soft and fine,** and is usually dyed either red or bright yellow. It is much used for the uppers of **fancy slippers** and **shoes** and for **binding books.**

Lesson XV

HIDES AND LEATHER

Place on the table the specimens of leather used in the last lesson, and some further specimens of stout heavy leather. Some oak bark, and a solution of the bark in a bottle for experiment will also be required.

I. INTRODUCTION

SHOW the specimens of leather which were used in the last lesson, *and commence by leading the children to compare any one of these with the raw skin from which it was made.*

1. The skin would easily decay and rot away; the **leather cannot rot.**

2. The raw skin was porous; it would absorb moisture. **Leather is impervious** or **water-proof,** because its pores have been filled up.

3. The raw skin is thin, soft, and flabby; the **leather** made from it **is thick, stout, and strong,** and **so hard and tough** that it will stand a great deal of rough usage. It is **very durable.**

A few well-chosen questions will serve to elicit all these points, and then the children should be called upon to explain that it was the soaking in the **alum-and-salt liquor,** *which brought about these changes. We call the work of preparation* **tawing the skins,** *and the leather made in this way is known as* **tawed leather.** *Sheep, lamb, goat and kid skins* **provide the material** *for tawed leather.*

Show now some specimens of the heavier sorts of leather.

What animals provide the skins for leather of this kind? **Cows** and **horses.**

What kind of skins are they? They are **thick, stout, heavy skins.**

How do we distinguish them from other skins? We call them **hides.**

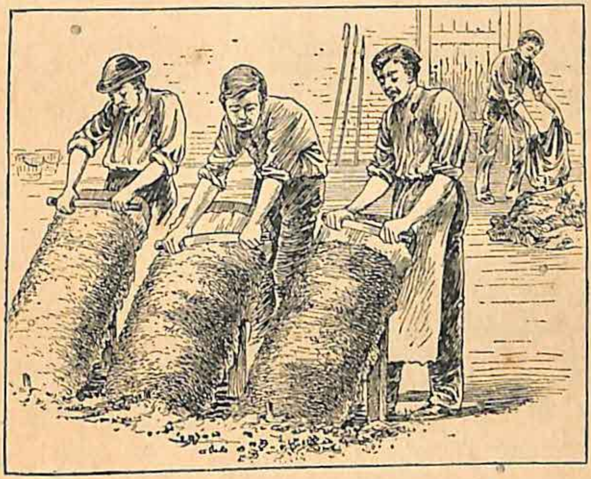
Tell that tawing with alum and salt would not change these thick hides into leather. They have to be prepared in another way.

II. Leather from Hides

Remind the children that oxen like sheep are slaughtered for food, and as the animals are killed, their skins are stripped off, and sent away, with the hairy covering still on them, to be made into leather. Lead them to tell, by referring to the last lesson, what must be the steps in the manufacture of these hides. The hair must be removed, the hides must be changed into actual leather, and the leather itself must be made fit for use.

1. **Preparation of the hides.**—The hides are first thrown into a great tank of water, and left there to soak for about a fortnight, **to cleanse them from some of the dirt, blood, and grease.** After this they are taken out and put into a deep pit or tank in the ground **filled with lime-water.** They remain soaking in the lime-water for about ten days, and during this time men day after day turn them about so that the lime may be able to act upon every part of the skin. **The lime-water causes the skin to swell,** and **loosens the roots of the hair.**

When they have been soaked sufficiently, the hides are taken out, and scraped with blunt knives on the outer side only, **to remove the hair,** which comes away easily with the scraping, because it is loosened at the roots.



Remind the children of the similar process in the preparation of the sheep-skins. What else was scraped away besides the loosened wool? **The outer layer of the skin.**

Tell that exactly the same thing happens here. The useless outer layer of the skin becomes loosened from the true skin by the lime-water, and **it is scraped away.**

When all the hair is removed, the hides are turned over to another set of men called **fleshers.** These men deal only with the under or **flesh side of the hide.** They scrape and cut away with sharp knives any **bits of flesh or fat** that may have been left on the skin, so that when their work is done, **nothing remains but the true skin**—the material required for making leather.

Tell that so far the lime has been very useful in swelling the hides and loosening the hair, but now that its work is done, **every particle of it must be got rid of** *as soon as possible, as it would be very injurious to the leather if it were left there.*

A liquor is made of fowls' dung and water, and the hides are soaked in this for about a week. **The liquor absorbs all the lime** that is left in them, and when they are taken out of it, they are ready to be made into leather.

2. **Tanning.**—*Remind the children once more that it is the soaking in the alum-and-salt solution which changes the sheep-skins into actual leather; and then tell that the same changes must take place in these thick hides, before they can be made into leather like the specimens on the table.*

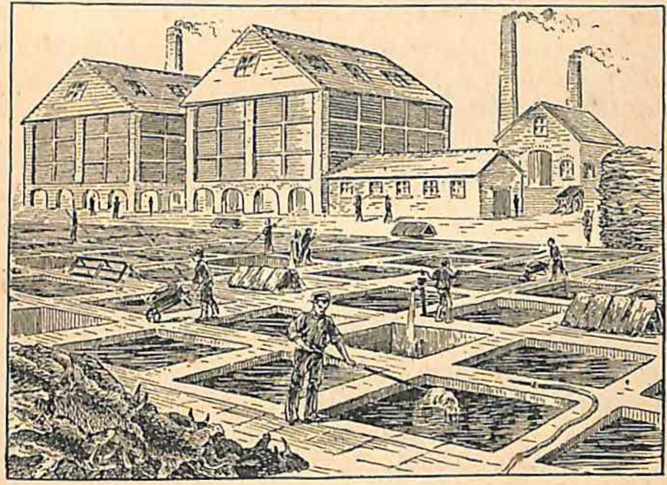
Explain that in this case the changes are brought about by a process called **tanning.** *It is so called because of the peculiar substance known as* **tan or tannin,** *which is used in the work. This tan is obtained from the* **bark of certain trees,** *but the* **oak and hemlock provide the best tan.**

Call upon the children to tell what happens when mother pours the boiling water on the dry tea or coffee at breakfast time. The water draws out and absorbs the properties of the tea or coffee. Tell that the tannin is obtained from the bark in a similar way to this. **The bark is crushed up small in a mill,** *and then* **soaked in water.** *As it soaks the water* **draws out and absorbs the tannin** *and other properties from it, and makes a liquor known as* **ooze.**

It would be well to provide some oak bark if possible, and prepare some of this liquor from it, so that the children may learn a little of its peculiar properties by their own observation. This would prove useful as a reference in the later stages, *when dealing with the tannin in tea, but of course no mention of the connection should be made here.*

A piece of raw skin might be easily obtai[illegible] from the butcher, and if it were put into a bottle with some o[illegible]his tannin liquor, the children would have an opportunity of s[illegible]g for themselves the effects of the soaking.

Describe the tan-yard at the leather factory. It is honeycombed everywhere with **deep pits or tanks sunk in the ground.** *The hides, as they leave the flesher, are thrown into these* **tan-pits,** *and then the prepared* **ooze,** *or* **bark liquor,** *is pumped in to cover them. The hides are left to soak in these pits for* **four or five months.** *This is called* **tanning the hides.**

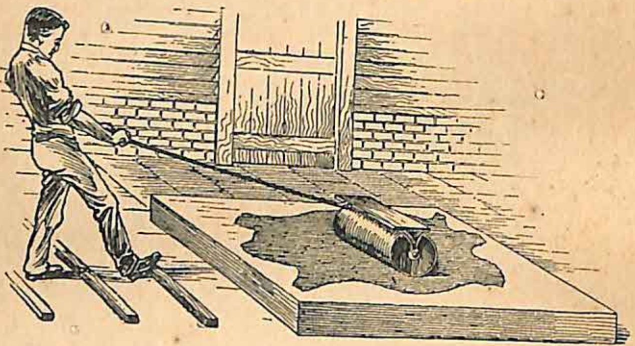


The tannin of the liquor soaks into the skins, **unites with the gelatine in them,** and **changes them into actual leather.** The longer they are allowed to remain in the tan-pits the better, for it is important that every particle of the gelatine shall be acted upon by the tannin, if the leather is to be of good quality.

Explain that at first only **a weak solution of the ooze** *is used, and that it is increased in strength from time to time, so that* **the strongest liquor comes last.** *The* **tanning process** *for some of the best leathers* **occupies over a year.**

Elicit from what has been shown that when the tannin has soaked through into every part, and the hide is ready to be taken out of the tan-pit, it is no longer a mere skin. It is real leather, which **will not rot and decay,** *but is* **strong, tough, durable, and water-proof.**

3. **Drying, rolling, and currying.**—The tanned



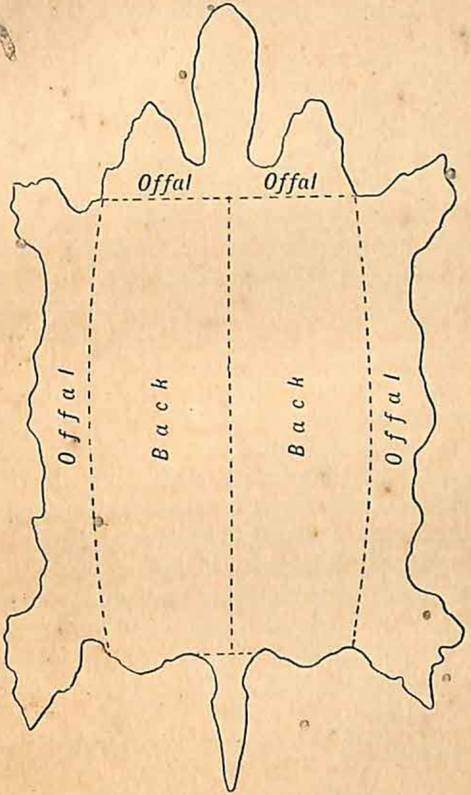
hides on being taken out of the pits, are first washed in clear water, and then laid out in open, airy lofts to dry, after which they have to undergo a great deal of hammering, and **rolling with heavy rollers** to harden them.

Some of the thickest sorts are **split into two** by machinery, but the flesh, or under side, is inferior to the upper or hair side of a split skin.

The thinner kinds of hides are used **for the uppers of boots,** and these are dressed with oil and tallow, and rubbed and rolled **to give them a smooth surface.** They are then blacked with lamp-black and tallow, and rubbed and smoothed and polished again. This last process is known as **currying.**

III. Varieties of Tanned Leather

Bull-hide, bullock-hide, and **cow-hide,** make the thickest, strongest; and most durable kind of leather, such as is used **for the soles of boots and shoes,** and for harness for horses.



Calf-skin is much lighter and thinner. The young calf provides a skin so thin and delicate in texture, that it is used for making **parchment.** Ordinary calf-skin is the material from which the **uppers of boots are made.**

The hides of the animals that are killed **before they are fully grown oxen,** are known as **"kips."** When these **kips** are tanned and dressed, they make a **very valuable leather,** almost as fine as calf-skin, but stouter and more durable. It is largely used for **the uppers of boots for men and boys.**

The hide of the horse is much **thinner than that of the ox**; but when it is tanned and curried it provides a very valuable leather, which is chiefly **used by the harness-maker. Pig-skin** is tanned into leather for covering **saddles.**

Tell that besides these domestic animals, many wild animals provide useful hides for the tanner. Among these are the **antelope, buffalo, porpoise, alligator, rhinoceros,** *and* **hippopotamus,** *and the skin of each one has its own special purpose.*

It will be interesting to the class to learn that there is great difference of quality even in the same hide. Remind them that in dealing with wool, we also found that one part of the fleece is not of equal value with other parts. The skin, as it is taken from the ox or the horse, is styled **the crop,** *or* **full hide.** *After it is tanned and dressed, it is cut up into* **the butt,** *and* **the offal.** *The butt is the* **best portion of the leather**; *the offal consists of that part of the skin which covered the* **shoulders, neck, cheeks, face,** *and* **under parts** *of the animal. Thus in a single ox-hide we have* **five distinct qualities of leather.**

Show a black-board sketch of the crop, with dotted lines to mark how it is cut up.

Lesson XVI

SILK

Provide specimens of as many varieties of silk fabrics as can be obtained, some silk-worms and caterpillars, pictures of common insects, and one or two beetle-pupa cases if possible.

I. ITS PROPERTIES

WE are going to deal with another clothing material today. Here are some pieces for you to examine. Can you tell me what the material is? It is **silk.**

Remind the children that we do not use silk for our common, everyday clothing. Mother likes to have a silk dress to wear on great occasions, but she takes care of it and makes it last a long time.

Why is this? Because silk is **very expensive.** Only rich people can afford to wear silk every day.

Point out that although silk is too expensive for many people, as a material for the whole garment, we all like to use it **as a trimming,** *to brighten up the other materials, and make them look smart.*

Look at your pieces of silk. What do you notice about them that makes them different from other materials? The silk has **a bright, shiny appearance.**

Explain that it is this **glossy, shiny appearance** *which makes silk such a beautiful, rich-looking material. We call it* **the lustre of the silk**; *and we say that* **silk is a lustrous material.**

Point out next that it is **soft** *and* **pliable,** *and therefore suitable as a material for clothing; that it is* **thin** *and* **light,** *and yet* **strong.** *Show that* **it does not tear easily.** *Prove its strength too by hanging a weight on a fine thread of silk. It will surprise the children to see what a heavy weight the thread will support without snapping in two.* **Silk will stand a good deal of hard wear.**

Lastly, lead the children to notice that the specimens before them were all made by weaving threads together to form a web. Silk is a **woven** *or* **textile material.** *It had to be* **spun into yarn,** *and* **woven in a loom** *just like the woollen and worsted goods.*

II. What it is

Pull out one of the threads from a piece of the silk, and proceed to untwist it, the children doing the same with their specimens. Call attention to the **extremely fine, loose, flossy material,** *of which this twisted thread is composed. Show some* **raw silk,** *and compare the two.*

This is the raw material from which the beautiful silk fabrics are made. We must now find out what it is and where it comes from.

Elicit from the class that wool, fur, leather, all formed a covering for the animal before we took them to make clothing for ourselves—that, on account of this, we call them animal substances.

Silk, too, is an **animal substance,** although it never formed the coat or covering of any animal. It was **made by a sort of caterpillar** called the **silk-worm.**

Show a picture of the silk-worm, or better still, an actual silk-worm, if it can be obtained. Point out that the name is a bad one, for the creature **is not a worm.** *Elicit that worms are entirely without legs, and then point to* **the six legs in front,** *and* **the ten, thick, fleshy-looking feet** *at the hinder part of the silk-worm's body. The silk-worm is not really a worm.*

Look at the creature now. What will you think when I tell you that its own mother was **a beautiful moth, with wings** for flying? Yet it is quite true. A little mouse, a kitten, or a lamb is exactly the same kind of animal as its mother. But the silk-worm **is so unlike its own mother,** that she would not know her young one if she could see it. Yet the strangest thing of all is that this silk-worm **will one day be a moth** like its mother if it lives long enough.

III. Insects—their Life-History

Before we can understand the nature of the silk-worm, and why and how it makes the silk, we must glance at the class of animals to which it belongs.

Here is a picture of a well-known little animal. What is it called ? A fly.

Yes, that is the common house-fly. Do you see any other animals that you know in the picture ?

The children will of course readily recognise and point out the bees, butterflies, moths, and beetles.

These little animals all belong to one class. We call them **insects.** Let us see why.

Turn to one of them—the fly or the bee for preference—and point out that it appears to be **deeply cut across in two places,** *so as to be nearly separated into* **three distinct parts.**

This is why we call it an **insect.** The word **in-sect** means **cut into.** Butterflies, moths, and beetles have the same kind of bodies as the fly and the bee. They are **cut across in the same way,** so that the body looks as if it were made up of three parts. **Butterflies, moths, beetles, bees,** and **flies** are all **insects.**

Tell that all insects are **hatched from eggs.** *The mother insect lays an immense number of eggs, but she never sees her own little ones, for* **she dies immediately afterwards.**

Picture the hen and the mother cat. How carefully they look after their little helpless family, and feed them. Excite the curiosity of the children to learn what can become of those very helpless little things that come out of the insects' eggs. They have no mother to care for them. Tell that the mother insect seems to know she will not be there to feed her little ones, when they are hatched, and so **she provides for all their wants before she dies.**

Explain that the most curious part of it all is that the food which she herself lives upon **would be of no use to her little ones**—*they would not touch it. She must know this, for she always lays her eggs where there will be* **plenty of the very food they like best.**

Illustrate this by pointing out that the fly lays its eggs **in the meat** *in the butcher's shop, beetles lay their eggs* **on a dung-hill,** *moths and butterflies* **on the plants** *in the garden, and so on.*

The Larva.—In due time the egg is hatched, and out creeps, not a beautiful creature with wings, like the parent insect, but **an ugly, crawling thing,** which we call the **Larva.**

The larva which comes from the egg of the common house-fly is a **maggot.** The young of butterflies and moths are **caterpillars**; those of beetles are called **grubs.**

They are all **hungry little feeders**; they spend all their time eating and growing, and they usually throw off and **renew their skins** several times before they are full grown

Explain that it is always the larvæ of the insects that do the damage to the plants in the garden.

The Pupa.—When the grubs, caterpillars, or maggots have reached their full growth, they roll themselves up in **a sort of case** or **oval box,** and there remain **while they cast their last skin,** neither eating, nor moving, nor showing the least sign of life all this time.

Show, if possible, specimens of the **brown, shiny, oval cases of the beetle pupa,** *which may be found in or near dung-heaps.*

The creature at this stage of its existence is known as **a pupa,** or **chrysalis.** At last when all is ready, it wakes up as it were, and comes out of its case, no longer in the larva state, but **furnished with legs and wings,** to fit it for a new life as **a perfect insect.**

Promise to explain in the next lesson what all this has to do with silk and the silk-worm.

Lesson XVII

SILK AND THE SILK-WORM

The teacher should be provided with some silk-worms, moths, cocoons, and eggs, and a few mulberry leaves if possible. A picture of the mulberry tree should also be at hand, and a picture of the reeling process would be useful.

I. LIFE-HISTORY OF THE SILK-WORM

COMMENCE by leading the children to tell all they can of the nature of an insect. Let them describe in their own words the changes **from grub to pupa,** *and* **from pupa to perfect insect.**

Remind them that this change of form is **common to all insect-life.** *Every one of these little creatures commences life in a form altogether different from that of its parent.*

Produce now **the silk-worm moths,** *and let the children examine them. Notice the* **thick hairy body, the six stout legs,** *and* **the two pairs of large white wings,** *streaked crosswise with dark bands.*

Tell that these moths are **the perfect insects;** *they are the parents of future silk-worms. The female is* **larger than the male,** *and not quite the same in shape. She lays from* **250 to 400 eggs,** *smaller than grains of mustard-seed. Show some of the eggs, if possible, and then produce* **the silk-worms**—*the full-grown caterpillars or grubs that come from the eggs.*

Where does the butterfly lay its eggs? On the leaves of the plants in the garden.

Why? The leaves are **the natural food** of the caterpillars which come from the eggs.

Tell of the wonderful instinct of the mother insect in laying her eggs in the midst of the very food which the young grubs will require. The tiny things which come from the eggs are **mere threads at first;** *they would have no strength to* *travel in search of their food. The mother arranges so that they begin life* **with their proper food all round them;** *they have nothing to do but eat and grow.*

The favourite food of the silk-worm is **the leaf of the mulberry tree,** and wherever mulberry trees are plentiful, there silk-worms are found.

People who rear silk-worms **provide a constant supply of fresh mulberry leaves** for them to eat.

The grub when hatched leaves the egg in the form of **a little black worm,** not more than ¼ inch in length, but there is plenty of food at hand, and **it feeds greedily and grows rapidly.**

Lead the children to tell that the growing grubs of all insects cast their skin from time to time, as it becomes too small for them, and that **a new skin is always ready to take its place.** *Tell that this change of skin is known as* **moulting.** *Refer to the moulting of birds.*

The **caterpillar life** of the silk-worm lasts for **six or eight weeks,** and during this time there are **four moults.** The first moult takes place about **eight or ten days after it leaves the egg.** Each of these changes seems to bring **renewed appetite and vigour,** for the creature feeds more greedily and grows more rapidly than ever.

After the last moult it continues to feed and grow in this way for about ten days, and it may then be said to have **reached its full size.**

Show one of the silk-worms which has finished feeding and is just **about to commence spinning.** *Here is a full-grown silk-worm. Measure it. It measures* **about 2½ inches** *in length. Notice its* **sixteen legs**—*three pairs of legs in front* **like all insects,** *and* **five pairs of stumpy fleshy-looking feet** *behind. The body, which is of an ashy or cream colour, is made up of* **twelve jointed parts,** *the last joint of which is* **horned.**

Call attention to the peculiar way in which the full-grown silk-worms crawl about, **moving their heads from side to side** *continually. Tell that they are looking about for some* *light object, such as a twig, a bit of straw, or a piece of paper, to which they may fasten themselves.*

This done, they commence to send out, **from two small holes under the jaw,** a fine yellow gummy substance, which hardens into **a silky thread or fibre** in the air. With this silky material the creature wraps itself up completely **as in a ball.** It is preparing for its change into the **pupa** or **chrysalis.** We call the ball **a cocoon.**

II. The Cocoon

Explain that the grubs of many insects, when about to enter the pupa or chrysalis state, wrap themselves up in a kind of silky covering which they spin with material from their own bodies. The destructive **rose-maggot** *may always be met with in the spring curled up in a leaf of the tree* **in a loose flossy covering** *of its own spinning. Most caterpillars prepare for the chrysalis stage in the same way,* **but the silk which they spin is useless.**

The silk-worm spends the first day in forming **a loose flossy covering** for the **outside of the ball.** This it afterwards **coats with gum,** so as to make it into a kind of **outer skin.**

Inside this during the next three days, it spins **a firm ball of fine but strong yellow fibre,** which is the silk which provides us with the material for clothing.

Show **a cocoon.** *Explain that when the spinning is all over, the animal—whatever it is—***is in the centre.** *It is* **not a silk-worm**; *it is* **not a moth.** *It is* **a lumpy, oval ball,** *covered with a shiny skin or shell, but it is to all appearance lifeless. It is* **the silk-worm chrysalis.**

Open one of the cocoons, and show the chrysalis within.

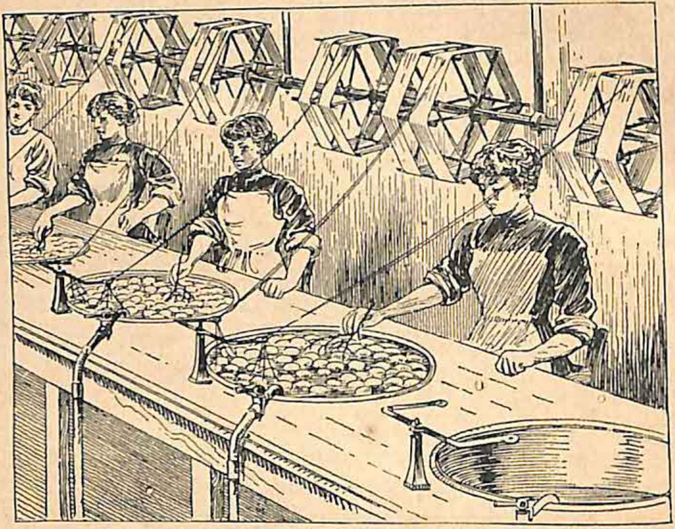
Tell that after about **ten or fifteen days** *the chrysalis would, if left to itself, show plainly enough that it was not lifeless. During its imprisonment in the cocoon* **it undergoes wonderful changes,** *and when the right time comes, it works its way out of the ball, not as a grub, not as a chrysalis, but* **as a winged moth able to fly in the air.**

After living long enough in the new stage **to lay the eggs of a future race of silk-worms,** the moth dies.

III. HOW THE SILK IS OBTAINED

Tell that the silk is never so good if the moth is allowed to work its way out, as it is from a cocoon that has not been opened.

People who rear silk-worms always **kill the chrysalis** before it becomes an actual moth. This is done either by throwing the cocoons into **boiling water, by steaming them,** or by putting them **into a hot oven** for a few minutes. The hot water or the steam is best as it **softens the gum** on the outside of the cocoon, so that the loose outer skin is easily pushed aside to allow the inner ball of fine silky fibre to be taken out.



Point out the delicate nature of the silky threads of the cocoon. The process of unwinding the silk without breaking the thread must be performed with great care. Remind them that *as the silk-worm* **commenced its spinning work from the outside,** *the first step in unwinding the silk is* **to find the outer end of the thread.** *Tell how this is done.*

The cocoons are thrown into **pans of water,** which stand on a long table in front of the **reeling machines.** They are so light that they float on the water, and the girls who attend to the machines have to fish out with a twig the loose **floating end of the thread** and place it on the reel. With care the rest is easy. The reel turns so smoothly, that the whole of the thread of the cocoon is wound off without a break.

From the reel the silk is made up into **bundles or hanks,** and is known as **raw silk.** A single cocoon usually yields **from 300 to 500 yards** of silk, but in some cases more. It is calculated that **250 cocoons weigh 1 lb.,** and as it takes 12 lbs. of these cocoons to make 1 lb. of silk, it follows that **1 lb. of raw silk** is the work of no fewer than **3000 silk-worms.**

Remind the children that this raw silk has to be spun and woven into materials for use, like other textile fabrics.

Lesson XVIII

FEATHERS

Articles required for illustration: a bird of some sort, either a live one in a cage or a stuffed specimen, a few quill feathers, a sharp pocket-knife, as many specimens of feathers as can be obtained, and a small eider-down quilt if one could be borrowed for the lesson.

I. Introduction

Commence by reminding the children that we have still the lightest, warmest, and most beautiful of all animal coverings to consider. All birds are clothed with feathers, and they provide us with another material for our use.

Elicit from the children a few of the uses to which feathers are put, e.g. *some are used for* **adorning and trimming**

ladies' hats and bonnets, *some for making* **muffs** *and* **victorines,** *some for* **stuffing beds, pillows, cushions, quilts,** *and so forth.*

Explain that, before we can understand their fitness for these different uses, we must learn something about the nature of the feathers themselves.

II. KINDS OF FEATHERS ON THE BIRD'S BODY

Show a bird of some sort. Spread out the wings and tail, and call attention to the long feathers in both.

These we call the **quill-feathers.** The bird makes use of them in flying.

Notice next the smaller feathers, which cover the whole of the body. These we call the **clothing** *or* **body-feathers.** *Run the finger along them the wrong way, and then smooth them back to their proper position, and let the children see how beautifully these feathers are arranged,* **one overlapping the other** *so as to form a* **close-fitting coat.**

Beneath these clothing feathers, and next to the skin, are some **very small soft, fluffy feathers.** These are called **down.** There are some big birds to be seen in shops at Christmas time, and they have a very thick, close covering of down.

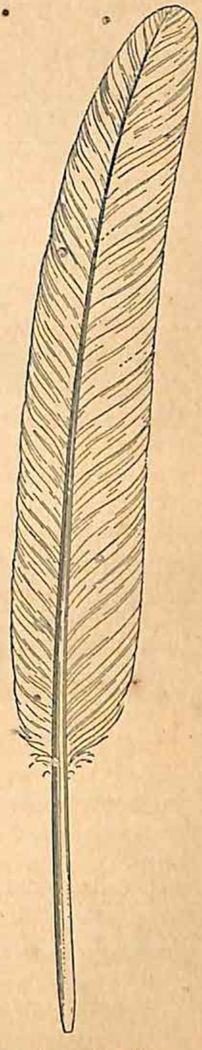
What birds do I mean? **Ducks** and **Geese.**

Lead the children to tell that these birds spend much of their time during all seasons of the year in the water; and that **this close-fitting under-jacket of down** *is meant as a special protection against the cold. Compare it with the close* **under-jacket of the fur animals.**

Thus, there are three distinct kinds of feathers on the bird's body—the **quill-feathers** of the wings and tail; the **clothing feathers** which cover the body, and the **under-jacket of down,** which is thickest and warmest in the water-birds.

III. PARTS OF A FEATHER

Hand a few quill-feathers round the class for examination, *and lead the children to point out the various parts, the teacher giving each its proper name.*



1. **The quill.**—This is the **main stem** of the feather. Its root is fixed in the skin of the bird, just as the hairs are fixed into the skin of our head.

Cut one of them across with a sharp knife. Let the children examine it, and tell that it is really **a rounded, hollow tube.**

Let them try to cut their quills. They find it is not such an easy matter as it seems, for although the quill is **thin and light,** *it is made of a* **very strong, tough, horny substance.**

Test another in various ways to show that it will bear a great deal of rough usage without breaking. When it is bent or twisted it springs back to its original shape. It is **very elastic.**

2. **The shaft.**—This is the continuation of the quill to the tip of the feather. It is made of the same **tough, light, horny, and elastic substance** as the quill.

Let the children examine it. Point out that it has **four sides**—*that the upper and under sides are* **smooth** *and* **more or less glossy,** *and that there are* **long slender blades** *closely set* **along the other two sides.** *Strip one of the feathers to show this.*

Cut open a shaft, and point out that instead of being hollow like the quill, it is filled with a peculiar, **light, tough, white substance**—*the* **pith.**

3. **The Web.**—*Show next the long, narrow, flat pieces or* **blades** *which spring from both sides of the shaft. Call attention to their long tapering form.*

Let the children pluck one or two from their feathers. We call them **barbs.**

Notice how these barbs are arranged **with their flat sides close together.**

Show that they always point towards the tip of the feather, and **away from the quill.**

Run the finger along a feather the wrong way, and show how the barbs ruffle up; then draw it up the feather towards the tip, and the barbs at once close together again, and the feather is as smooth as before.

Explain that this arrangement of the barbs is not accidental. It is a wise design **to keep the bird warm** *and to* **assist it in its flight.**

All the feathers on the body of the bird, for the same reason, point backwards. Thus, as the bird moves through the air, **its feathers are pressed closely to its body,** and the barbs of each feather are pressed close together, all pointing in the same direction.

Show how great an assistance this is to the bird in its flight.

Each barb is furnished at both edges with an immense number of very small blades—**the barbules.**

Explain the meaning of the words—**barb, barbule.**

The barbules are really **little hooks,** and they interlock themselves one in the other, and so **hold the barbs of the web close together.**

IV. USES OF FEATHERS

1. **Feathers for ornament.**—The quill feathers from large birds, such as the ostrich, emu, osprey, egret, swan, turkey, peacock, pheasant, eagle, grebe, and cock are mostly used for this purpose; but when we come to the small birds, it is often not merely the feathers, but **the whole body of the bird** that is prepared for adorning hats and bonnets.

The teacher would do well to picture to the girls some of the most brilliantly plumaged of these small birds, such as the **birds-of-paradise, humming-birds** *and others, and* **endeavour**

to enlist sympathy *for them by pointing out the wholesale slaughter that must take place, when ladies of fashion require such adornment. They either do not know, or do not think of the cruelties practised and the slaughter carried on against these most beautiful of the feathered race, or they would set some other fashion.*

Tell of the ostrich farms in Africa where the feathers are regularly plucked **from living birds.**

2. **Stuffing feathers.**—The clothing or body-feathers of birds, especially of **poultry-birds** and **wild-fowl,** are largely used for **stuffing beds, pillows,** and **cushions.** These birds are killed for food, and the feathers, of course, are plucked from their dead bodies.

The feathers require little preparation. They are first **sifted** to separate the smaller feathers from the larger and coarser ones; then **dried** and **beaten** to remove dust, and then **baked in an oven** to kill any vermin they may have on them.

3. **Down,** the soft, fluffy under-vest of water birds, is highly valued. The best down is obtained from the **eider-duck** and the **swan.** The eider-duck is a native of Iceland and Norway. As the bird is not used for food, the down has to be obtained in a curious way.

Tell that the mother bird makes her nest on the rocky sea-shore in the spring, and **lines it with down from her own breast.** *In this nest she begins to lay her eggs, and day after day men go round, and take away some of the down and some of the eggs.*

The bird then **plucks more down from her breast,** *and lays more eggs in the nest, only to have it robbed as before, and so on, until she can spare no more.*

If an eider-down quilt could be borrowed for the lesson, it would give the children an idea of **the extreme lightness of the material.** *Yet it makes* **the warmest of coverings for a bed.**

Lesson XIX

COTTON

The teacher should be provided with specimens of the various fabrics mentioned in the lesson. Some sheep's wool, cotton-wool, raw cotton, reels of sewing-cotton, pictures of a cotton plant and the cotton plantation, a few sycamore leaves, and a hollyhock flower will also be required. Place, in readiness for the lesson, two brass balls in a basin of boiling water, and in sight of the children take the balls out of the water and wrap them up—one in flannel, the other in calico. Let them then lie on the table till they are required in the course of the lesson.

I. Introduction

Produce the piece of white calico, and commence by leading the children to tell the name, and mention some of the uses of this new material. They will readily tell from their own observation that calico is the material commonly used for **articles of underclothing, sheets** *and* **pillow-slips** *for the bed,* **night-dresses** *and so on.*

Call attention to some child's **print frock** *or* **pinafore.** *Explain that this too is made of calico. It was once* **a piece of white calico,** *just like that on the table, till the pretty pattern was made on it.*

Let the children examine some pieces of calico for themselves, and lead them to tell that it is **a textile material.** *It was* **woven in a loom,** *just like woollen and silk materials.*

Set them to pull out some of the threads and untwist them to show that the substance of which this material is made **was spun,** *like all other textile materials,* **into yarn,** *before it was woven into cloth.*

Show some **cotton-wool** *without telling its name, and explain that this is the* **raw material** *of which calico is made. Let the children examine it.*

What does it look like? It **looks like wool.**

It really is wool; we call it **cotton-wool,** and we sometimes speak of **calico** as **cotton-cloth.**

Compare the specimen with some sheep's wool. Explain that this cotton-wool **does not grow on the back of the sheep, but on a plant.** *It is* **a vegetable, not an animal substance.**

Not only calico and print, but **chintz, cretonne,** and **muslin** are made of this cotton-wool. **Flannelette,** a very soft, useful, woolly kind of cloth is also made of cotton, and so are **stockings** and **hosiery** of all kinds, and beautiful **lace** both for **clothing** and also for **curtains for the house.** It is the material from which **corduroy, moleskin, fustian, velveteen,** and other stout, strong sorts of clothing for men and boys' wear are made. Cotton in fact **clothes more people** all over the world **than any other material.**

Show specimens of as many of these materials as possible.

Show also some reels of **sewing thread.** *Remind the children of the great usefulness of this thread in making up the various materials into garments.*

Tell that this too is **made of cotton.** *We call it* **sewing-cotton.**

II. Properties

Let the children handle and examine the specimens and the cotton-wool from which they are made, and so lead them to find out for themselves the more obvious properties of the material; after which the teacher should proceed to educe others, which would be likely to escape the observation of the class. In this way it will be easy to show the peculiar fitness of cotton as a clothing material.

They will easily tell that it is **a soft** *and* **pliable material,** *and is therefore* **easily worked**; *that although* **very light** *it is* **warm to the touch.** *If they run their finger over the material, they will find that the surface is covered with* **a soft, fluffy down.** *It is this which* **makes it feel warm.**

Now let us have a very simple experiment. I will pour a little water into the bottom of this plate, and lay one of these pieces of calico in it. Notice what takes place. The water **soaks into the calico at once,** and wets it all over.

What does this tell us? It tells us that the **calico is very absorbent.**

Explain that this is a very useful property, for it makes the calico **a good washing material.** *Print dresses, pinafores, and aprons* **get soiled and dirty with wear,** *and so does our underclothing. As the material is very* **porous** *and* **absorbent,** *the dirt* **easily washes out** *of the articles when they are put into the water. We are able to change such clothing frequently, and it comes back clean and wholesome again for us to wear.*

When do we like to wear our print dresses? In the **summer time.** Why? Because **they are cooler** than our other clothing.

Let us next find out why they are cooler. Think of the furs and woollen materials. How do they keep us warm? They **prevent the heat from passing away** out of our bodies.

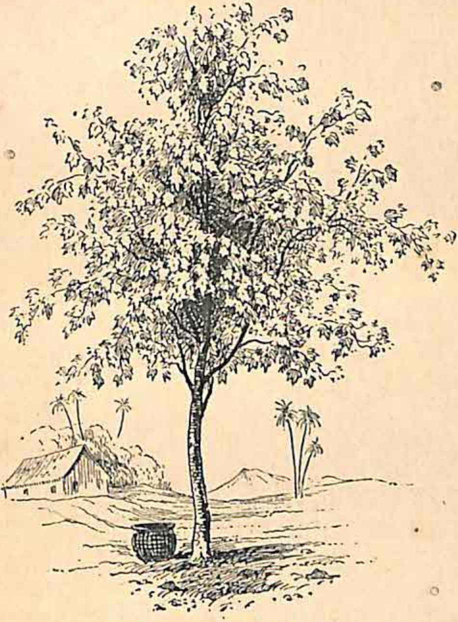
I think another little experiment will now make the whole thing quite clear. I have here two brass balls. You saw me take them out of the hot water at the beginning of the lesson, and wrap them up—one in **flannel,** the other in **calico.** You noticed that when I took them out of the water **they were too hot to hold.** Let us examine them now.

Set one of the girls to take out the ball from the calico wrapper. She will find that it is now so cool that **she can easily hold it in her hand.** *Instruct her next to take the other one out of the flannel. This is still so hot that* **she cannot hold it; she drops it in a moment.** *What does this mean?*

Explain that both balls were equally hot at first, for they came out of the same hot water. Since they have been lying on the table, the flannel round the one **has kept the heat in.** *That ball is almost as hot as it was at first. But the calico* *wrapper round the other* **has let a great deal of the heat escape,** *so that* **the ball itself has got cool** *enough to handle.*

Calico for this reason is a good material for summer clothing. It keeps the body cool **by allowing some of its heat to escape** into the air.

Explain that it is **not a good material** *to wear* **next to the skin,** *even in the summer. It is* **porous** *and* **absorbent** *and* **soaks up the perspiration;** *but then as it lets the heat of the body pass away rapidly,* **it becomes cold, wet, and clammy to the skin.** *It would cause us to catch cold.*



THE COTTON TREE.

III. What Cotton is

We have already said that cotton is a **vegetable**

substance, and grows on a plant. Cotton really grows on several different kinds of plants. One is **a tree from 15 to 20 feet in height,** another is **a shrub,** and another is **a small annual plant about 3 feet high.** All the cotton which we use comes from this small plant.

Elicit from the class that an annual is a plant which **lives for one season only.** *The seeds are sown in the spring, and the plant grows up, reaches maturity, and dies down the same season. Call upon them to give examples of other annuals.*

The cotton plant requires about seven months to come to maturity, and it is very tender—the least sign of frost would wither it up. It would not grow here in our short summer, but in the hot lands where it does grow, the fields are planted with cotton plants, just as ours are planted with corn or cabbages. A field planted with cotton is called **a cotton plantation.**

Show a picture of a cotton plantation, with **the lightly-clad negro men and women** *at work in it, and lead the children to form from this a mind picture of* **the sort of climate the plant requires.**

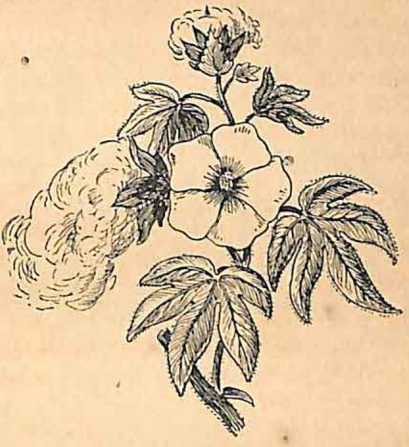
THE COTTON PLANT.

The plant itself is something like **a gooseberry bush** in size and shape. It bears **bright green leaves,** not unlike those of **the sycamore,** and **large yellow flowers,** very much after the style of **the hollyhock.** When the flower falls off, **it leaves behind a pod** about the size of a large walnut.

Show a picture of the plant, and if possible have a few sycamore leaves and a hollyhock for illustration.

The pods contain **a great number of little black seeds,** which lie in the midst of **a loose, white, woolly down.** This is the **raw cotton.**

As the pods ripen, **they burst open,** one by one, and the **white, fluffy wool** is seen hanging out of them. This is the time for **the cotton harvest**—a very busy time when men, women, and children, most of them negroes, are hard at work from early morning till dark **picking the cotton.** As it is picked it is laid out in the sun to dry, and when quite dry it is ready to be separated from the seeds. This is done by a machine called **a gin**—the process is known as **ginning.**



Describe it. The gin is **a sort of box,** *the bottom of which is formed of strong parallel wires, about one-eighth of an inch apart. Between these wires upright circular saws revolve continually. The box is loosely filled with the newly picked cotton, and as the saws revolve,* **their teeth drag the cotton through the bars,** *and the seeds are left behind.*

This cotton, cleaned from the seeds, is then **packed in great bales** and sent away by ships to England **to be spun and woven** into materials for clothing.

Lesson XX

LINEN

Provide specimens of all the textile materials named in the lesson, a well-ironed collar or cuff, some linen thread, a piece of lint, a bundle of raw flax, a picture of the flax plant, or an actual growing plant if it can be obtained, pods containing linseed, specimens of linseed meal, linseed oil, oil-cake, a dried flax plant, an iron comb, some coarse tow, and a specimen of the scutched fibres.

I. INTRODUCTION

HAND round to each child a specimen of household linen, and a similar one of white calico, and commence the lesson by calling upon the class to examine and compare them, first finding out the points in which the specimens are alike, and afterwards those in which they differ.

Of course they will see at once that **both are white materials**; *and under the teacher's guidance they will readily point out that* **both are textile fabrics,** *for the threads in each may be clearly seen crossing one another at right angles.*

Lead them next to examine closely **the surface of each specimen,** *and they will discover that* **one is covered with a loose, fluffy down, or nap,** *but that* **the other is very smooth and glossy.**

Let each girl place the two materials against her cheek—the downy one first, and afterwards the smooth one, and in this way lead them to tell what they observe through the sense of touch. **The downy material feels warm; the smooth one much colder** *in comparison.*

Lastly, set them to pull out a thread from each material, and test the two for strength. They will learn that the thread from **the smooth glossy material is very strong**—*it will stand a great deal of pulling and stretching before it will break;*

the thread from **the other material breaks more easily** *—it is not nearly so strong.*

These two materials, then, although alike in some respects, are not the same. One of them we have seen before. Which is it? This one with the warm, soft nap.

What is its name? Calico.

What is it made of? It is made of cotton.

The smooth glossy material before you is not made of cotton. It is made of **flax,** and is called **linen.** Linen is **a more beautiful fabric** than cotton, and it is **much stronger** and **more durable,** because the fibres of which its threads are made are stronger than the fibres of the cotton-wool.

II. Linen Materials and their Uses

Show specimens of as many of the linen fabrics as can be obtained, calling attention to the great variety and beauty of these materials.

Some are **fine and thin,** others are **coarse** and **stout in texture,** but all of them are valued because of their **durability** and their **smooth glossy appearance.**

Hand round the class the specimens of fine linen. Tell that this is the material of which **shirt-fronts, cuffs,** *and* **collars** *are made. Show a well-ironed collar or cuff, and lead the children to tell what they can of the starching and ironing process, which has given the article its* **smooth, glossy lustre.** *Tell that* **calico,** *with its fluffy nap,* **could never be made to look like this.**

Explain, too, that linen being a stronger material than calico is more suitable for those parts of the shirt (like the collar and cuffs) **which have the hardest wear;** *and that the starch, by making the linen stiff,* **helps it to keep clean longer.**

Show next the specimens of **damask, diaper, cambric,** *and* **lawn,** *and lead the children to give the uses of each, assisting, of course, where necessary.*

These are all the finest of the linen fabrics. Among the coarser materials are **household linen** (used for sheets and pillow-slips for the bed), **huckaback** and other **towelling, holland** and **apron linen, bed-ticking** and **duck.**

Hand round specimens of these. Very little description will be necessary; the name of the material suggests the uses to which it is put. Notice in passing the advantage of linen over cotton for **tea-cloths** *and* **glass-cloths** *for washing-up purposes in the kitchen. Some of the fluffy down of a cotton cloth is sure to come off with the rubbing, and plates and dishes, cups and saucers, and glasses, are not nice to use if they have been dried with a cloth of this material. A linen cloth* **leaves the articles nicely polished** *without any bits of fluff sticking to them.*

Show some **linen thread,** *and elicit its uses.*

Tell that linen thread is used in preference to cotton for sewing purposes, especially in making up clothing for men and boys, **where strength is required.**

Show, too, **a piece of lint.** *Tell of its use in* **dressing wounds** *and* **sores.** *Explain that it is made by shredding old linen into fibres* **to make a sort of tow.** *If the wound is bound up with this lint,* **there is no fluffy down** *to rub off and stick to the sore place. For the same reason* **linen rag is always better than cotton** *for dressing a wound.*

III. FLAX AND THE FLAX PLANT

I have already told you that linen is made of flax. We must next find out what this flax is.

Show a **bundle of raw flax,** *and tell that these rough-looking fibres are the material from which the beautiful linen is made. Let the children examine it for themselves.*

Does it look like an animal substance or a vegetable substance? A vegetable substance. Yes, it is more like a whisp of hay than anything else. It is a **vegetable substance,** although unlike the raw cotton **it is not found** with the seeds, **in the seed-pods of the plant.**

Show a picture of the flax plant; or better still, if the lesson can be timed for the summer, produce an actual growing plant, and lead the children to describe it.

It is a small plant with **long slender stalks**, between 2 and 3 feet in height, and it bears **narrow, pointed leaves,** and **pretty little blue flowers.**

Stand the flower-pot on the floor, and point out that the tops of the stalks reach just above the teacher's table.

Explain that the plant is **an annual,** *and grows in the fields as we grow corn and other crops. It is easily grown; the seed is sown in the spring, and the plants are in full flower and* **ready for use in July.**

After a time the flower dies off, and leaves behind **a pod**, or seed-vessel, containing **ten little, flat, oval seeds.**

Show one of the pods. Let the children see it opened. Count out the seeds on a sheet of white paper, and hand them round the class for inspection. Inquire whether any girl knows the name of these seeds. If not, tell that they are called **linseed.** *Explain that* **linum** *is Latin for* **flax.** *Hence the name* **lin-seed,** *which simply means* **flax-seed.**

Show from this the connection between **linum, linen, lint, lin-seed**; *write each word and its meaning on the blackboard.*

Tell the uses to which the seeds are put.

Ground into powder they give **linseed-meal.** What use do we make of that?

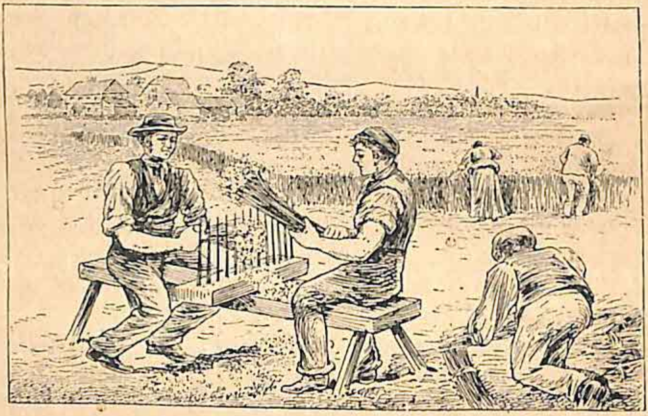
Pressed in a mill they yield a valuable oil **(linseed-oil),** and the solid part left behind is **oil-cake** which is used for **feeding cattle.**

The flax plant grows in hot countries like India, and also in colder lands such as the North of Ireland, Scotland, Belgium, Holland, and Russia. In hot countries **it is grown specially for its seeds**; in the colder parts of the world nearer home, it is **the material for linen** that is wanted, **not the seeds.**

But where does the raw material for linen come from? *Show, if possible, a dried flax plant. Call attention to the* **fibrous nature of the stalks.** *Compare them with the bundle of raw flax, and tell that these are the source of the raw material.*

IV. PREPARING THE RAW MATERIAL

When the flax is ready for harvest, men, women, and children are sent into the fields **to uproot the plants by hand.** They are all pulled up separately, carefully dried in the sun, and laid in order, crossing each other with the root ends all pointing one way.



Remind the children that these raw stalks must require considerable preparation before they can provide fit material to be spun into yarn and woven into linen fabrics.

1. **Rippling.**—This is the first process in the preparation, and **it consists in removing the seed-pods** from the stalks.

Describe the way in which it is done. Men called **ripplers** *sit in front of a coarse iron comb, fixed with its* **teeth upper-**

most. *This is called the* **ripple.** *The men separate the seed-pods by drawing the stalks through the comb.*

Illustrate by drawing some coarse tow through a comb.

2. **Retting or rotting.**—The stalks are **steeped, root downwards,** in a shallow pool, for ten or twelve days, and afterwards spread out side by side on the ground.

Explain that this **rots away the softer fleshy parts** *of the stalk, and at the same time leaves the hard woody parts very* **brittle,** *so that they may be easily removed afterwards.*

3. **Scutching.**—This process consists of beating the stalks with wooden mallets, so as to **break up and remove those hard woody parts.** When this is done, nothing is left but some **rough-looking fibres,** which once formed the **inner bark** of the stalks. These fibres are the material from which the beautiful linen fabrics are made.

Show a bundle of these **scutched fibres.** *Point out that the fibres are of various lengths, that some look* **coarse and rough,** *some* **fine.** *Tell that these rough fibres have to undergo a great deal of combing and preparation before they are fit for the spinning machine.*

Lesson XXI

BLEACHING

The teacher should provide herself with specimens of all the fabrics mentioned in the lessons, and the raw materials from which they are made, some roll brimstone, and a small tin dish, a red rose, some ammonia, a garment of some sort made of unbleached calico, two large basins, some chloride of lime, and sulphuric acid, specimens of British gum.

INTRODUCTION

Show the specimens of white calico and linen, a white silk handkerchief, and some article (a wrap for the throat) made of *white Berlin wool. Ask one of the girls to come to the table and pick out the raw materials—cotton, flax, silk, and wool, from which these things are made.*

Compare the **snowy whiteness** *of each of these manufactured articles with the* **original colour of the raw material**; *and proceed in some such way as this:—*

Here is some wool just as it was cut off the sheep. What would you do with it to make it as white as this? Wash it.

Very well. Let us think for a moment about our lessons on wool. What is the very first step in the manufacture of this material? It is **sorted** and **washed.** Yes, and it is washed very thoroughly too in hot water and soap. What did we call this washing? **Scouring the wool.**

And what name did we give to the wool after it had been washed? We called it **scoured wool.**

Call upon one of the children to find the specimen of this scoured wool on the table. Compare it with the raw and also with the manufactured article. Show that it is whiter than the one, but not nearly so white as the other.

This tells us that the washing and scouring did not make the wool white. No amount of washing would make this wool as white as that. How then can it have been done?

Crush some sulphur small, place it in a tin plate, and suspend over it a flower of some sort (such as a red rose) which has been previously dipped into water and shaken. Ignite the sulphur, and it will burn with a blue flame, and give off, as it burns, a noxious suffocating gas. As the fumes of this burning sulphur rise round the flower, its **red colour will slowly disappear.** *If a piece of coloured silk be suspended side by side with the flower the result will be the same*—**the fumes will rob the silk of its colour.**

N.B.—Before attempting to explain what has been shown, let the burning sulphur be removed from the room; for the fumes are a powerful throat irritant; they cannot be breathed without giving rise to violent coughing. When this has been done proceed as follows:—

What has happened to the flower and the silk? They have **lost their colour**; they are white now.

Yes, the fumes of that burning sulphur **have turned them white.** We say they have been **bleached.** The natural colour of each of the textile materials—wool, silk, cotton, and linen—has to be changed to white, in like manner, **by a bleaching process of some sort.** Our next business is to learn how this is done.

II. Wool and Silk

Explain that the bleaching process is different for different materials. Elicit from the children that cotton and linen are **vegetable,** *wool and silk* **animal products.**

Tell that the process is practically the same for cotton as for linen, but this would be altogether **unsuitable for wool or silk.**

Our experiment will help you to easily understand the bleaching of wool and silk, for it is a very simple matter. It consists of two processes—**cleansing** and **bleaching.**

1. Cleansing.—Wool is first steeped in warm rain-water, to which a little ammonia has been added, and it is afterwards well rinsed in clear cold water.

Show some ammonia. Let the children smell it. Most of them will recognise it as the familiar **hartshorn.** *Tell that it will at once seize upon the smallest particle of grease. Its purpose here is* **to get rid of any of the oily matter** *that may happen to remain in the wool after the scouring.*

Silk is simply boiled for an hour in soap and water, **to remove any of the gummy matter** that may be left on it, and it is then rinsed in clear cold water.

2. Bleaching.—All that remains is to remove the colour. This is done by placing the cleansed material in a closed chamber **filled with the fumes of burning sulphur.** When it is taken out it has lost its natural colour, and is white, like the silk handkerchief and the woollen wrap.

III. COTTON AND LINEN

Show the specimen of white calico once more, and have in readiness the piece of grey cotton cloth.

What has been done to this to make it white? It has been **bleached.**

What might we call it? **Bleached calico.**

This piece too is calico, but it is not white. Has it been bleached? No.

What shall we call this then? **Unbleached calico.**

Explain and show that this is **the natural colour of the raw cotton.** *Tell that the raw material is always spun and woven in this state. It is known as* **grey cotton** *or* **unbleached calico.** *It is cheaper than the white (bleached) calico, and for this reason some people prefer it.*

Show a garment made of new unbleached calico, and compare it with one made of the same material, which has been worn and washed many times. Point out that this one has lost its light-brown colour; it is now **almost as white** *as the bleached material. Tell that* **the air and the sunshine,** *each time the article has been washed and dried, have made this change, and explain that in old times this was the only method of bleaching which people knew.*

It is much better of course to make the new garments of beautiful bleached calico, than to wait till the unbleached ones wash white, because these are only just beginning to get a good colour when they are almost worn out. Let us see how the bleaching is done.

Fill two large basins with water. Into one throw a handful of **chloride of lime,** *and into the other pour a few drops of* **oil of vitriol—sulphuric acid.** *Stir both well, and then place a piece of the brown unbleached calico in the first and leave it there to soak for a few minutes.*

While it is soaking take the opportunity of giving a simple description of the chloride of lime. Hand some of it round the class in a saucer. Call attention to its **powerful smell.** *Some of the children in all probability have already become* *acquainted with it as* **a disinfectant.** *These young children will not, of course, understand the term disinfectant, nor is it necessary that they should. But they are very likely to have seen it used in cases of sickness.*

Explain its use in that direction in a simple way. **It prevents those catching diseases from spreading** *to other people, because it destroys the bad smell from them, and so purifies the air. Tell that it will bleach our piece of calico* **by destroying the brown colouring matter in it,** *and because it does this it is also called* **bleaching powder.**

N.B.—This is all that need be said to a class of such young children. The mysteries of chlorine and slaked lime, and the reactions that take place may be safely left for the present.

Now take the calico out of the first basin and immerse it in the second. Let the children see for themselves what happens. The material **rapidly loses its brown colour.** *When it is taken out it is* **much whiter than it was.**

Tell that it is not yet quite bleached. To get rid of all the colour it would be necessary to first wash the material in **soda-and-water,** *and then repeat the double bath.*

Explain that the bleaching powder and acid would not be suitable for bleaching wool and silk, for **they would destroy those materials.** *That is why they are bleached in another way. Even calico has to be well washed and boiled after the bleaching* **to get rid of all the acid** *for that would rot the material.*

This experiment will give a very good idea of the way in which calico is bleached in the factories; but a great many lengths of the material are sewn together end to end, so that several miles of the stuff are bleached at one time.

Linen is bleached in practically the same way as cotton.

Show and compare pieces of **brown Holland** *and* **household linen.**

Lastly, take a piece of bleached calico, and rub it in the hands. Call attention to the **white powder** *that falls from it. Tell that this is the* **dressing,** *and is intended to give the* *new material* **a better appearance** *or finish. Explain how it is done.*

The bleached cloth is steeped in a solution of **British gum,** and afterwards dried between hot rollers. British gum is made **by baking starch in a moderately hot oven.** Ordinary starch is not soluble in water, but **the baking makes it soluble,** and it is then called British gum.

Lesson XXII

DYEING

Articles required: specimens of all the fabrics mentioned, some madder, logwood, fustic, quercitron, indigo, saffron, cochineal, one or two samples of the aniline dyes, specimens of calico print, a kettle of boiling water and two basins.

I. Introduction

Show the specimens of white calico and linen, and the white silk and woollen articles used in the last lesson. Elicit from the class that the natural colour of each of these materials has been removed, and the fabric made white by bleaching.

Lead the children next, by referring to their own clothing, to tell that very few articles of wearing apparel, with the exception of the under garments, are made of white material.

Their own every-day observation too will tell them that, whether the material be wool, silk, cotton, or linen, **coloured clothing is much more common than white.**

Show specimens of as many coloured fabrics of all kinds as possible. Tell that each of these materials **was once white,** *like the white specimens on the table, for they have* **all been through the bleacher's hands.** *After they had been bleached, these new and permanent colours were given to them by another process, called* **dyeing.**

Before proceeding to describe the principles of dyeing, have it clearly understood that wool, silk, cotton, and linen, whether *intended for the dyer, or for the market, to be sold as white goods,* **must undergo the bleaching process.** *The natural colour of the material must be taken away* **before the dyer can give it the new tint.**

II. Dye-Stuffs

The dyer uses a great variety of colouring matters in his work. Some of them are obtained from the **vegetable,** some from the **animal,** and some from the **mineral kingdom**; but plants supply most of the substances used.

The **root** of one plant, the **woody trunk** of another, the **bark** of another, the **leaves** and **stalks** of another, the **flowers** of another, and the **berries** of another, supply the dyer with colouring materials to suit all his purposes.

N.B.—It is not necessary to enter into exact details with regard to these substances, but it would be well to provide specimens of a few if possible. Let them be produced one by one and briefly described as follows:—

Madder, a red dye-stuff, is obtained from the **root** of a plant. The root is dried, and ground into a powder, and used in that form.

Logwood is the **heart-wood of a tree** which grows in America.

Throw some chips of the wood into boiling water, and show **the rich red infusion. The chips themselves are used** *in this way for dyeing purposes.*

Fustic, the wood of another American tree, yields **a beautiful yellow dye** when similarly treated.

The bark of the yellow oak (quercitron) also produces **a fine yellow dye.**

Indigo, the most important of the blue dyes, is obtained from the juices of the **stalks and leaves** of a plant.

Saffron, a yellow colouring matter, is obtained from **the centre of the flower** of a kind of crocus.

Show some **cochineal** *in a saucer. Pass it round for the children to examine the little grains for themselves. Point out that each of those little grains is* **the dead body of an insect**—*the* **cochineal insect.** *Put some of them into a basin and pour boiling water on them. Let the children see* **the beautiful, rich, crimson infusion** *that is made.*

Soak a piece of flannel in the infusion, wring it out, and hang before the fire to dry. Notice that **the material has taken the new colour—it is dyed red.**

While it is drying proceed with a brief and simple description of the mineral dyes.

One or two specimens of the **aniline dyes** *will suffice as examples of those derived from mineral sources. Tell that these are obtained from* **coal-tar,** *as one of the off-products of* **gas-making.** *They yield a great variety of beautiful colours.*

III. The Work of Dyeing

Turn now to the piece of flannel. It is probably dry by this time; if not, dry it.

Remind the children that it was white at first. It is red now, **dyed red by the cochineal infusion.**

Show another piece of properly-dyed red flannel. Set two girls to wash them in separate basins. Call upon the class to notice that in one case the water instantly becomes reddened— **the dye is washing out** *of the flannel we dyed with the cochineal; but the other water is not coloured, because* **that dye does not wash out.** *The colour seems* **fixed to the material.**

It is clear we have not dyed our piece of flannel properly, or the colour would remain fixed as it is in this piece. It would not wash out.

The dyer **fixes his dyes to the material** by the help of certain substances which he calls **mordants.** The word **mordant** comes from a French word which means **biting.** The name was first given to these substances, because they **seem to bite into the material,** as it were, and hold it and the colouring matter together, **so that they cannot be separated.**

A great many different substances are used as mordants for fixing the dyes to the materials. It does not concern us now to inquire **what they are.** All we want to remember is **what they do.** Without a mordant of some sort nearly all the colouring matters would wash out of the material, but **the dyer uses the mordant as well as the dye,** and so fixes the colour.

N.B.—These mordants are all chemicals (salts of iron, copper, and tin are amongst those most commonly used), and of course it would be useless to try to make these young children understand the nature of substances of this kind.

Explain that the dyer dissolves the mordant (whatever it may be) in water, and soaks the material in this solution **before he applies the dye-stuff.** *This is the usual plan of dyeing, but* **sometimes the dye and the mordant are mixed together,** *and the material is dyed by the one dipping. In either case the colour is* **fixed.** *Tell that the shopkeeper describes the materials dyed with a good fixing mordant as* **fast colours.**

If time permit, a piece of wool or silk should be dipped in a solution of aniline dye. After drying, the colour would be found to be fast, **although no mordant was used.** *This would afford the opportunity of explaining the curious fact that these* **aniline dyes,** *and* **the blue dye indigo** *differ from all the other colouring matters, in that* **they require no mordant to fix them.**

IV. Calico-Printing

Show a piece of print. Call attention to the pattern on it. Tell that before this pattern was put on it, the material was an ordinary piece of **white cotton cloth,** *just fresh from the hands of the bleacher. Explain in a simple way what has been done to it.*

A suitable **mordant** is mixed into a paste **with British**

gum, and this is **laid on the material** by machinery **to form the pattern.**

Compare this process with the printing of a sheet of paper by a printing press.

We say the pattern is **printed on the calico,** but when the material has been dried, it is impossible to see any pattern on it, because the mordant itself is colourless, and leaves no mark or stain. But the mordant is there **wherever the pattern is to be**; and when the cloth is put into the dye and afterwards washed, the colour fixes upon those parts only, while **everywhere else it washes out.** In this way the calico is **dyed in patterns,** and we call it **calico-print.**

Lesson XXIII

CLOTHING FOR WINTER AND SUMMER

Provide the following articles for illustration:—A small clinical thermometer, and three or four ordinary thermometers (tubes only, without the usual wooden framework); a basin, some ice, a Bunsen burner, a flask, a retort-stand, and specimens of all the materials named. Wrap up two of the thermometers, one in fur, the other in linen, before the lesson begins.

I. Introduction

In dealing thus far with the various materials used for clothing the aim has been to limit the teaching to simple facts, suited to the capacity of the children, without burdening the memory with too many names. But the time has now arrived, when they may safely be led a step further.

They will readily tell for instance which of the clothing materials are best suited for winter wear. But if they are asked to give the reason, their answer will be limited to the fact that certain materials keep us warm, **because they prevent the bodily heat from escaping.**

This of course would be a very good answer, and would show *that they had grasped the principles of the subject, as far as they have been taught in the foregoing lessons. But the purpose of this lesson is to review what has already been taught, and so help them to express themselves more correctly in future.*

II. Thermometers

Produce the **small clinical thermometer** *that was used in Lesson II.*

The children of course will recognise the instrument at once. Lead them in some such way as this to tell all they can about it.

You all remember this little instrument. What do we call this **silvery-looking stuff** at the bottom of the tube? It has two names **mercury** and **quicksilver.**

We used the instrument in one of our lessons. Do you remember what we did with it? We held it in our mouths.

What happened then? It told us the **exact heat of our body.**

How can it do that? The **mercury** at the bottom of the tube **swells up when it gets warm**; it rises in a thin line up the middle of the tube.

How far did it rise when I put it into your mouth? As far as the mark—**blood-heat.**

What did that show? It showed that I was **quite well.**

Why? Because the mercury always rises to this mark, **and no further,** when people are in good health.

How does it act when the body is **hot and feverish** through ill-health? It **rises higher** than the mark—blood-heat.

Lead the children to see from this that the instrument really measures the heat of the body. Tell that we might call it the **heat-measurer,** *and in this way introduce its actual name,* **thermometer.** *Write the word* **thermo-meter** *on the black-board, and explain its meaning*—**heat-measurer.**

Produce one of the ordinary thermometers next. Let the children examine it and compare it with the first. They will see that it is a similar kind of instrument, but larger than the other.

Explain that this one is also a thermometer—**a heat-measurer**; *it is at present* **measuring the heat of this room.**

Point out the mark—blood-heat—on it, and then show that the top of the mercury, which tells the heat of the room, is **much below that mark.**

What does this mean? It means that the air of the room is **not nearly so warm** as the blood in our bodies.

Tell that the other instruments lying on the table are also measuring the heat of the room, and then let the children examine them, and find that the mercury in all of them stands at **exactly the same level.** *Of course this should be done without any mention of degrees for the present.*

Place one of these thermometers in a basin of ice crushed very small, and another in the neck of a flask of water boiling over the Bunsen burner. The children will observe the mercury **sink in one tube** *and* **rise in the other.** *Call upon them to explain what it means; and lead them at last to find the* **Freezing** *and* **Boiling Points.**

III. WHAT THE THERMOMETER TELLS

Call attention to the specimens of fur, flannel, cloth, silk, feathers, calico, and linen on the table.

Let one of the girls come to the front and lay her hand on each of them in succession, and tell what she observes.

She will say that the first five all **feel much warmer** *to the touch than either the* **calico** *or the* **linen**—*that the* **linen strikes colder** *than any of them.*

Now show the other pieces of fur and linen in which the thermometers are wrapped. Remind them that these instruments will tell exactly how warm the two materials are. They cannot make any mistake.

Then remove them from the wrappers, and let the children see that the **mercury in both is at the same height.**

The fur is really **no warmer than the linen,** although it feels so much warmer when we touch it.

What does this mean?

IV. CONDUCTION OF HEAT

Ask one of the girls to come to the front and take the poker out of the fire.

The rest will observe that the instant she touches it she draws her hand away.

Why is this? The poker is hot; it burnt her hand.

But she touched the handle, not the part that was in the fire. How can the handle be hot?

Explain that **the heat** *from the fire* **travels along the poker** *little by little, till the* **handle itself becomes hot,** *as well as the part which is actually in the fire.*

We say that the heat travels along the poker by **conduction**; that the iron **conducts** or **carries** the heat along; and that it is a **good conductor** of heat.

Point out that it conducted the heat **so quickly** *into the girl's hand that the* **skin would have been burnt,** *if she had not drawn it away.*

Fold a piece of **woollen cloth** *or* **flannel** *into two or three thicknesses, and show that, by using this as a pad, the* **poker may be safely taken up** *and held, without any danger of burning the hand.*

What is the meaning of this? The **flannel prevents the heat from passing out** of the poker. It cannot get to the hand.

Let the same girl try to do it with two or three thicknesses of calico or linen for a pad. She cannot hold the poker long; the **heat soon strikes through,** *and begins to burn her hand.*

Point out that the calico and linen **do not keep the heat in the iron** *as the flannel did; they help it to escape.*

Which of these three—calico, linen, and flannel—are most like the iron itself in this respect? The **calico** and **linen.**

What name did we give to iron because it helped the heat to pass away? We called it a **good conductor of heat.**

Explain that for the same reason we say **calico** *and* **linen are good conductors** *of heat. They* **conduct** *or carry* **the heat away,** *and so does every kind of material made of cotton and flax.*

Flannel and all woollen materials are **bad conductors**; *they hold the heat in, and* **prevent it from escaping.**

Remind the children now of the little experiment with the heated brass balls in Lesson XIX. Let them tell what took place.

Why was the ball which we took out of the calico wrapper almost cold, while the other in the flannel was still hot? Because **calico is a good conductor**—it allowed the heat to pass away; but **flannel is a bad conductor,** and keeps the heat in.

Point out that flannel is an **animal substance,** *made of wool, and tell that all the animal substances—fur, silk, feathers, as well as wool—would have acted in the same way.* **They are all bad conductors** *of heat.*

Perhaps you can now tell me why the calico and linen felt cold, and the other materials warm, when you touched them? The calico and linen are **good conductors—they took away heat from the hand,** and that made the hand feel cold. The other materials are **bad conductors—they prevented the heat of the hand from passing away.** That is why they felt warmer than the others.

Tell that for this reason cotton and linen materials make **the best clothing for hot weather.** *They keep the body cool, because they are good conductors, and* **allow some of the heat to escape into the air.**

The animal substances—fur, wool, silk, and feathers—are for the express purpose of **keeping the body warm,** *because, being bad conductors, they* **prevent the bodily heat from passing away** *too rapidly.*

Lesson XXIV

CLOTHING FOR WET WEATHER

The teacher will require a piece of sheet gutta-percha, and some smaller specimens of the material for experimental purposes, a basin, a kettle of boiling water, pictures of the gutta-percha and india-rubber trees, pieces of tweed and some waterproof materials, a sheet of india-rubber, and a specimen of common bottle rubber, an india-rubber golosh, specimens of coal-tar naphtha, turpentine, benzole, and india-rubber solution.

I. INTRODUCTION

COMMENCE by pointing out that we not only want a certain kind of clothing to keep us warm in cold weather, and another kind to keep us cool in hot weather, but we must also have clothing of still another kind **to keep us dry** *in wet, rainy weather.*

The children will, of course, readily tell that their boots and shoes do this for their feet. Call upon them to explain why leather is suitable for this purpose. It is **impervious to water,** *or* **water-proof.**

Boots and shoes made of thick woollen cloth, or felt, would keep the feet warm; but what would happen to them if we stepped into a puddle of water?

Nothing but an **impervious material could keep the feet dry.**

II. GUTTA-PERCHA

Produce the sheet of gutta-percha. Tell what it is called, and write the name on the black-board. Explain that this material is often used instead of leather **for the soles of boots.** Let us try to find out why.

1. **Its Properties.**—*Pass some of the specimen pieces round the class, and put the rest in the hot water.*

Call upon the children to examine their specimens, and elicit from them, step by step, that—

(1) *Gutta-percha is a* **smooth, brown, leathery-looking** *material.*

(2) *It is exceedingly* **tough** *and* **strong**; *they* **cannot tear it,** *try as they will.*

(3) *It is so* **hard** *that they have some difficulty in cutting it with a sharp knife.*

Gutta-percha is a good material for the soles of boots and shoes, **because it will stand a great deal of rough, hard wear and tear.**

Take the pieces out of the hot water, distribute them among the children, and lead them to discover what change has taken place.

The gutta-percha **has become soft** in the hot water.

Set them to squeeze it and work it up in their fingers. They will find that the material can now be **moulded into any shape** *they please.*

What shall we say about this warm, soft, gutta-percha, because we can mould it into any shape? It is **plastic.**

Show another piece that was treated in a similar way before the lesson. It is cold now, and **instead of being soft and plastic,** *it is* **hard.** *It* **retains the shape** *that was given to it when it was plastic.*

Tell that in using this material for the soles of boots it is first heated and **made plastic,** *then* **moulded** *to the shape of the boots, and then fixed, cut, and trimmed,* **while it is still soft.** *As it cools* **it hardens again.**

Let the children stand their pieces of soft, plastic gutta-percha aside, to examine when cool.

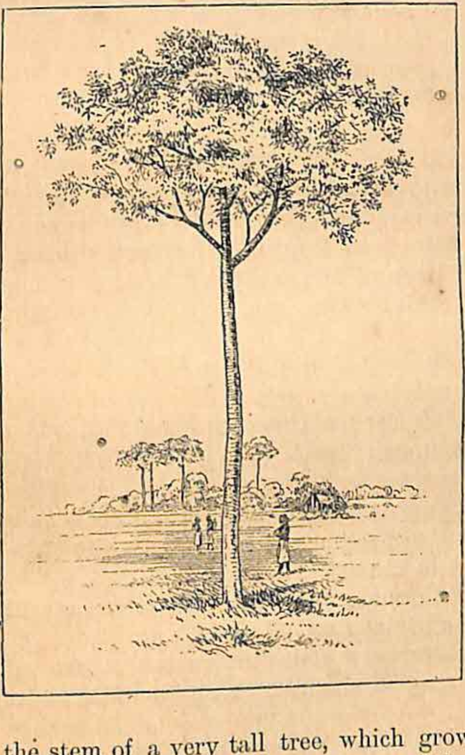
Proceed next to take another piece of the material out of the water, and mould it into the form of **a little basin,** *purposely making the sides of the basin* **as thin as possible.** *Show by pouring some water into the basin, that the* **gutta-percha** *is* **impervious** *or* **water-proof.**

Gutta-percha makes **excellent soles for boots and shoes,** because water cannot soak through the material. It **keeps the feet dry** and it is not itself injured by the wet.

Hold a piece in the flame of the gas, and show that **it soon takes fire,** *and burns with a white flame, giving off a powerful smell, and a great deal of black smoke.*

Gutta-percha soled boots **must never be put near the fire.**

2. **What it is.**—Gutta-percha comes from the **sap** or **juice** in the stem of a very tall tree, which grows in the tropical parts of the world. *Show a picture of the tree.*



When the tree is in its prime, if a hole is made in the trunk, a **thick, milky juice flows out,** hardening rapidly into a **solid,** as it is exposed to the air.

Every year as the season comes round men go through the forests and test the trees to find which of them are best suited for their purpose.

These they cut down, and as the bark is stripped off, the **white, milky juice oozes out,** and is caught in vessels placed to receive it.

As it reaches the air **it hardens** into a rough, shapeless lump, which has only to be purified from the dirt and rubbish that gets mixed with it, and it is then ready for use.

III. WATER-PROOF CLOTHING.

1. **Nature of the material.**—*Produce the piece of tweed. Explain what it is, and let two of the girls hold it out by the four corners, while some water is poured on it. Observe that the water soon* **begins to spread,** *and after a time* **trickles through the material** *to the floor below.*

Why is this? The cloth, like all other textile materials, is **porous.**

Let us see whether you are right in saying that all textile materials are porous.

Have a piece of **water-proof material** *held out now in a similar way, and fill it with water as before. Point out that this, like the other, is* **a textile material.** *The threads of the* **warp** *and* **woof** *can plainly be seen. Yet in spite of this the* **water does not soak through it.**

Why does the water not trickle through this material, as it did through the other? This one is **not porous.** If it were the water would soak through.

What do we say about materials that are not porous? We say they are **impervious to water,** or **water-proof.**

This piece of cloth then is a **water-proof material.**

What name do we give to the cloaks which we wear in rainy weather? Water-proofs.

Deduce from this that the cloaks get their familiar name, because they are made of some kind of **water-proof material,** *like this piece of cloth.*

A water-proof cloak protects us from the rain, because **it will not allow the wet to soak through** to the garments underneath. The rain would soon soak through an ordinary jacket or cloak, because the material of which it is made is not water-proof.

2. **How it is made.**—*Produce the sheet of india-rubber, and treat it in precisely the same way as the pieces of cloth were treated.* **India-rubber is impervious** *or* **water-proof.**

Tell that, because of this property, india-rubber is used for making **over-shoes,** *to keep the feet dry in wet weather, and that it is* **india-rubber** *which* **has made the piece of cloth water-proof.**

Explain that at first this cloth was porous like all other cloth, but that after it was woven, india-rubber was spread all over it, **as butter is spread on a slice of bread.** *This of course will rouse the curiosity of the girls. Proceed to tell how it is done.*

Show a piece of common rubber (not vulcanised). Point out that it would be impossible to spread this on the cloth.

Explain that the **india-rubber must first be dissolved.** *Elicit from the class that sugar, salt, lime, alum, can be dissolved in water. They will know that india-rubber cannot be dissolved in this way, for they have often seen rubber-pipes used for conveying water.*

India-rubber is **insoluble in water**; but it is **soluble in coal-tar naphtha, turpentine,** and **benzole.** *Show these liquids if possible.*

The lump to be dissolved (which is exactly the same sort of material as the specimen before the class) is first **softened** by long soaking in **hot water,** and then it is **rolled out between iron rollers into sheets** not much thicker than a sheet of coarse brown paper.

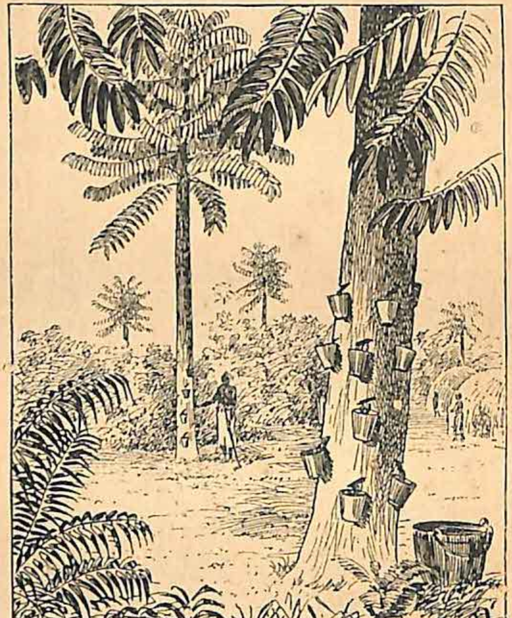
The sheets are put into **coal-tar naphtha,** and left to dissolve, and in a few days the **solid matter all disappears,** and there is a **solution of india-rubber,** something like treacle or tar in appearance.

Show a specimen of the solution, and point out that this substance is easily spread on the cloth.

When that has been done the material is hung up to dry. The **naphtha** part of the solution **flies off in vapour**, and leaves the cloth water-proof, because the **india-rubber fills up all its pores.**

3. **India-rubber, what it is.**—*This should be told briefly, with a picture of the tree for illustration, if possible.*

It is the **juice** or **sap** of an enormous tree which grows in the forests of Central and South America, and the East Indies. When the time comes for collecting the juice, a great many **slanting cuts** are made **in the bark** of the tree, and little cups are fixed below them to catch the **thick, yellowish-white liquid** which flows out.



Describe the work of collecting and drying the juice. Picture *the men going round from tree to tree and emptying the little cups, as they fill into larger vessels.*

Tell that this milky-looking juice dries and becomes a solid, **if it is exposed to the sun and air in thin layers.** *Explain the peculiar way in which this is done.*

A great many **queer-shaped clay moulds** are made, and these are first dipped in the liquid, and then **spread out in the sun to dry.** In this way **a thin coat or layer of india-rubber** forms all over the moulds, and then they are dipped and dried again and again, each time adding to the thickness of the layer, until it is thick enough.

The moulds are then broken up, and the lumps of raw rubber are ready to be packed and sent to England.

N.B.—*That is the mode of collecting and drying the juice in the East Indies. This sun-dried rubber is of a creamy white colour. The South American rubber is not sun-dried. The moulds are dipped in the juice and then dried over the smoke of wood fires, and this turns the material almost black.*

Lesson XXV

HATS

Provide for illustration a straw hat, a bundle of common straw, an old hat that may be ripped to pieces, specimens of straw-plait of various kinds, a felt hat, a black-board sketch of the felting machine.

I. INTRODUCTION

COMMENCE by calling upon the class to name the various articles of clothing which have been dealt with in the foregoing lessons, and the materials used for each.

There is still one important part of our clothing left for us to consider.

What name do we give to the covering for the head? We call it a hat or a bonnet.

Hats and bonnets then shall be the subject of our lesson to-day.

In the first place, why do we need a covering for the head?

Point out that all sensible people are as careful about covering the head **in summer** *as they are* **in winter.** *Remind the children of the power of the sun's rays on a hot summer day. Speak of* **the dangers of sunstroke.**

What is the object of wearing a hat in the hot weather? To shade the head from the sun's rays; **to keep the head cool.**

To do this the hat must be a large one. What kind of material should be used for making it? **A light material.**

Why? Because a large hat made of heavy material would be **uncomfortable** to wear; it would cause **headache.**

If it is to prevent the heat of the sun from striking through to the head, what else can you tell me about the nature of the material? It must be **a bad conductor of heat.**

Now think of the cold winter weather. What is the object of wearing a hat then? **To keep the head warm.**

How can it do that? It keeps off the cold winds, and at the same time prevents the heat of the head itself from escaping.

What is the only kind of material that can do this? **A bad conductor.**

II. STRAW HATS

1. **Properties of the Material.**—*Show the hat, and call upon the children to tell that it is made of straw. But what is straw?*

Lead them to think of their earlier lessons on the corn-plants, and remind them that the dried stalks of these corn-plants are **straw.**

The farmer, after threshing the corn, uses the straw **to make a bed** *for the horses and cows in the stable.*

Tell that the best wheaten straw, i.e. **the stalks of the wheat plant,** *provided the material of which this hat is made.*

Notice **the lightness of the material.** *Let the children take a bundle of straw in their hands. Elicit from them that it feels warm, and inquire as to the meaning of this.* **Straw is a bad conductor of heat.**

Explain that it is because of this that it makes **a warm snug bed for the cattle.** *It does not rob their body of its heat as they lie on it.*

Explain, too, that houses are sometimes **thatched with straw,** *and such houses are always* **cooler in summer** *and* **warmer in winter** *than any others. Let the children give the reason this time.*

Straw is one of the very best materials for covering the head, because it is **light to wear,** and **a non-conductor of heat.**

2. **Straw-plait.**—*Rip the old straw hat to pieces, and distribute portions of the* **plait** *among the children. Point out that the hat itself was made of these* **narrow strips or braids,** *which had been sewn together with thread.*

Let the girls now examine the braids themselves, and lead them to tell that they are made up of several narrow straws **plaited together.**

Tell that the material is called **straw-plait,** *and explain that it is made by* **a sort of weaving,** *except that, in place of the long threads and short threads (warp and woof) of the textile materials, we have* **the straws interlaced,** *or* **plaited,** *to form the web.*

When the straw is wanted for straw-plait, the wheat is cut before it is quite ripe, so that the stalks are **not allowed to get too brittle.** Some straws, after being cut into the required length, are merely pressed flat, and **plaited whole**; others are **split up** into four, six, or eight strips.

Show specimens of as many different kinds of straw-plait as can be obtained; and tell how the splitting is done.

A wire with four, six, or eight sharp ridges along it is forced up the hollow stalk, and so separates it into **strips of equal width,** and with a clean-cut edge.

Whether strips or whole straws are to be used for the material, they **must be kept moist,** in order to make them **flexible,** and prevent them from breaking while they are being plaited together.

Tell that the stalks of all the corn-grasses are suitable for the purpose, although **wheat straw is best.** *The finest of all comes from wheat grown in Italy, and this is made into* **Leghorn hats.** *Tell why they are so called.*

Explain that **grass, rushes, reeds,** *and various other fibrous substances, are used in addition to straw for plaiting* **hat-making materials.**

Bedfordshire, Hertfordshire, and Buckinghamshire, are the counties for straw-plait. The plaiting is done by women and girls. The children all plait. In the village schools of the district straw-plaiting is taught, side by side with needlework.

The plait, made at home in this way, is taken to **Luton, Dunstable,** and other market towns, and sold to the straw-hat and bonnet manufacturers.

Describe the work of hat-making briefly. The plait is **bleached** *white by hanging it in* **sulphur-fumes,** *then dyed if necessary, and afterwards sewn together and* **blocked to the proper shape.** *Remind the children of the lesson on bleaching.*

III. Felt Hats

1. **Properties.**—*Produce the felt hat. Let the girls examine and describe its* **smooth surface**—*almost as* **glossy** *as the* **nap of broadcloth.** *Notice, too, its suitability on the score of* **lightness.** *Elicit that it is* **a bad conductor,** *and call upon them to tell that they discovered this by handling it; for it feels warm to the touch.*

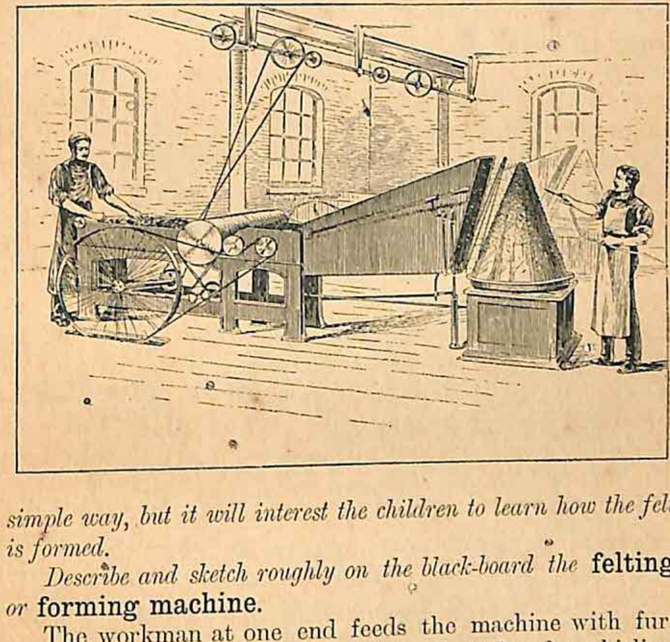
What material is used for making this felt? The **fur of hares and rabbits.**

Is all the fur of the animal's coat used for this purpose? No, only the **under fur.**

Why? Because the **over-hairs have no projecting teeth or scales**; they will not felt together.

How are the real fur and the over-hair separated? In a machine called a **Blower.** *Let the children tell briefly what takes place.*

2. **How the hat is made.**—*This need only be told in a simple way, but it will interest the children to learn how the felt is formed.*



Describe and sketch roughly on the black-board the **felting** *or* **forming machine.**

The workman at one end feeds the machine with fur. This is caught up and carried through it by the whirling motion of **a pair of rollers,** which revolve inside at the rate of **4000 times a minute.**

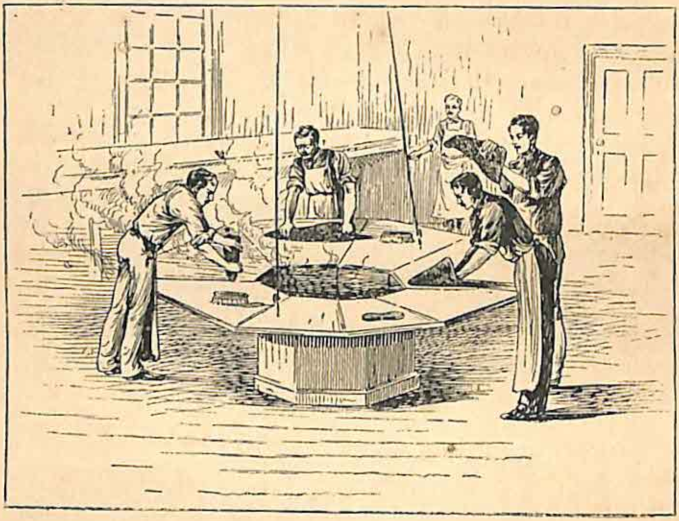
Point to the wide-open outlet at the opposite end. Tell that the motion of the air inside sends the fur out through this opening **in a light, drifting shower.**

Notice next **the large cone** *in front of this outlet.*

This cone is made of **sheet-copper**, and is **perforated** all over with fine holes. The stand on which it revolves is **an air-tight box.** Air can reach this box only **through the holes** on the surface of the cone.

What would happen if all the air could be taken out of this box? More air would rush in from the outside, **through the little holes,** to fill the box again.

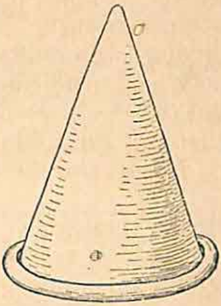
Explain that this is exactly what happens. Fans below are



constantly revolving at a rapid rate, and **exhaust the air in the chamber,** *and in this way* **currents of air** *from the outside* **are drawn in through the holes.** *The air, therefore, presses with great force all round the outside of the cone.*

As the fur fibres are driven through the machine, they fall upon the cone, and the pressure of the outer air towards the holes holds them fast, till at length the cone itself is **covered with a thin cap of fur.** The workman meanwhile lets a fine spray of boiling water play continuously over the cone, and the **air-pressure, warmth,** and **moisture** together **cause the fibres to felt.**

Compare the cone and the workman in point of size. Tell that this cap when taken off the cone would be **big enough for an elephant.** *At the same time it is much too flimsy and delicate in texture to be of any use.*



It has to undergo a process of **fulling,** similar to the fulling of broad-cloth. It is folded, pressed, and rolled again and again in boiling water **to make it felt still more,** till it becomes thickened in texture, and shrunk in size, by the combined action of the warmth, moisture, and pressure, and when all is over it comes out as **a conical felt hood,** which may be easily blocked into a hat of any shape for man or woman, boy or girl.

Lesson XXVI

OLD RAGS

Articles required for illustration: some specimens of shoddy cloth, a sheet of felt, some blotting-paper, printing and writing paper.

I. INTRODUCTION

INTRODUCE the lesson with a little chat about the pleasure of having a new frock or jacket. What becomes of the old one? It may be given away to some very poor child, and serve to clothe her for a time; or it may be too old and worn-out for that, and then it goes into the rag-bag.

What does mother do with the old rags in the rag-bag? She sends them to the rag-shop and sells them.

Take the children in imagination on a visit to one of these rag-shops.

Picture the great piles of rags of all kinds to be seen there. Most of them are the **tattered remains of old, worn-out garments,** *but among these are to be seen* **waste cuttings of new materials** *left by the tailor and the dressmaker.*

There are **greasy dish-cloths** *picked out of the dust-hole by the dustman, and* **filthy, foul-smelling rags** *fished up from the gutter, or the rubbish-heap, by the starving beggar and the tramp.*

Remind the children that it is quite possible that some of the **filthy, tattered rags** *in those heaps may once have been part of the* **rich dress of some lady of fashion.**

We often hear of the Queen sending a quantity of cast-off linen and other clothing to some hospital. These things, after doing duty **in the Royal household,** serve a useful purpose among the sick and suffering **at the hospital,** and when they get too old and worn for that, they pass into other hands, and are **patched and mended** as long as they will hang together. But they must at last wear out entirely, and so in the end **they too are sold for old rags.**

To look at the heap of filthy, foul-smelling rubbish in the shop, one would scarcely think it could be of much value. Yet even this rubbish must not be wasted; **every piece of it can be turned to good account.**

Picture the sorters at work sorting out the rags and packing them in great sacks. One sack is reserved for **scraps of old, worn-out woollen materials** *of all kinds—cloth, flannel, blanket, worsted stockings; another for* **tailors' cuttings of new cloth**; *another is filled with* **pieces of old calico** *and other cotton materials; another with* **old linen rags**—*and each is wanted for some special purpose.*

II. NEW CLOTH FROM OLD

1. **Shoddy.**—*Produce the piece of shoddy cloth. Say nothing about it for the present, but let the children examine it and compare it with a piece of new cloth. They will fail to notice any difference between the two.*

Show that both are made of wool, and then explain that the wool of one material is not quite the same as that of the other. Excite their curiosity by telling them that the first piece is made from **old worn-out woollen rags,** *which were once sold to the rag merchant at the rag-shop. Tell the name of the material—* **shoddy.**

This is **new cloth made from old.** Every scrap of woollen cloth, from the worn-out coat of the well-to-do man to the dirty, greasy, tattered rags of the beggar can be made **to do duty a second time**—to live, as it were, **a second life of usefulness.**

The teacher has here a good opportunity of inculcating **a remarkable lesson in thrift.** *Instead of burning and destroying these scraps of old cloth as useless waste, a way has been found of turning them to good account, and they actually become* **a great blessing to the poor,** *because the materials made from them are* **much cheaper** *than those made from wool fresh from the sheep's back.*

But why should they be so much cheaper?

Lead the children to see that the difference lies **in the cost of the raw material.** *The material for this shoddy cloth* **is bought at the price of old rags.** *Tell that all the tweeds and mixtures which are used to make* **cheap jackets** *for women and girls, and cheap* **suits** *for men and boys, are* **shoddy cloth.** *Poor people would not be able to buy warm clothing if it all had to be made of new wool.*

2. **Mungo.**—This is a similar kind of material to shoddy, but it is made of tailors' **cuttings of new cloth,** and not from old worn-out scraps. **Mungo** makes a **very good and useful material.**

3. **Making the new material.**—Dewsbury, Batley, Leeds, and other large towns in Yorkshire are **the great centres of the shoddy manufacture,** and the shoddy mills give employment to **many thousands of work people.**

Picture the trains coming into these towns from all quarters, laden with old rags to be made up into new material. Lead the children to tell that the first business at the shoddy mill must *be* **to cleanse the rags from dirt, filth, and grease** *of all sorts so as to make them fit to handle. Then proceed to describe briefly the work of shredding the material into* **"flock."**

The cleansed rags are thrown into an immense box, the sides of which are **set thick with long, sharp spikes.** Inside the box a sort of **drum** is kept constantly revolving by machinery, and **the drum itself,** like the walls of the box, is **provided with spikes.**

As the drum revolves, the spikes tear and rend the woollen rags into **shreds** or **flock** as it is called; and from **the fibres of this flock new yarn** is spun, to be woven into **new cloth** for future use

III. PAPER

Remind the children that there are cotton and linen rags in the rag-shop as well as woollen rags, and although they are not made into new clothing materials, we ought to know what becomes of them.

Tell that the cotton and linen rags are taken, **not to a shoddy mill** *but* **to a paper mill,** *for they are the material from which* **paper is made.**

Paper is made from various materials, but all the best paper is **made from rags,** and the finest and smoothest of writing-paper is made from **linen rags.**

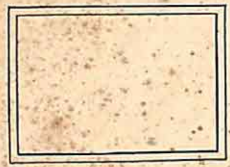
N.B.—*It should be borne in mind that this is not intended to be a lesson on paper and paper-making. Its only purpose here is to tell the use that is made of the cotton and linen materials of our cast-off clothing. Hence the principles only of the manufacture are all that need occupy the teacher's mind.*

1. **Cleansing the rags.**—*Describe the* **dusting machine.**

It is simply a large box with a **wire-gauze bottom, sharp spikes** all round its sides, and a **cylinder also provided with spikes** constantly revolving in it. The rags are thrown a few at a time into this box, and as the spikes turn round, they toss them about, and the dust and dirt fall out of them through the wire gauze.

The dusted rags are next cut up into small pieces, and **boiled** in large coppers, with **lime and soda** to remove the dirt and grease and colouring matter.

2. **Pulping the rags.**—The cleansed rags are next taken to the **rag-engine.** In this machine they are made to pass between **revolving knives,** which cut the material up into **the finest shreds.** This is then beaten up in water till the rag material **is changed into a pulp,** and it is this pulp which makes the paper.



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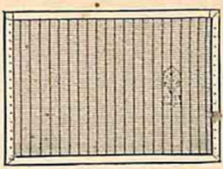

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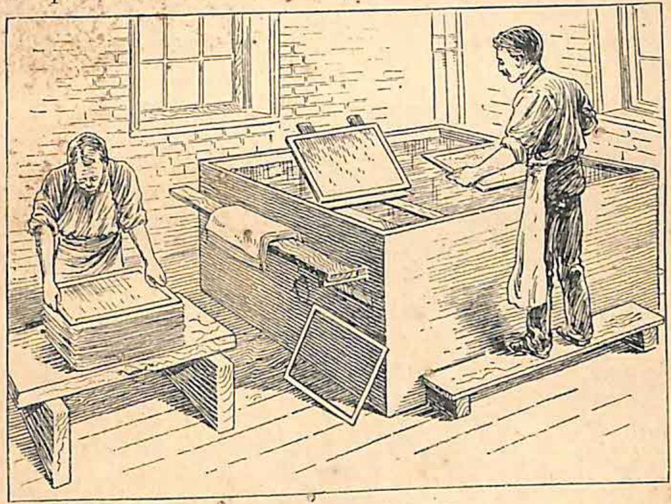


PAPER-MAKERS AT WORK.

The workman has **a mould** made of **wire cloth**, with a thin wooden frame, called a **deckle**, fitting round it. He dips the mould into the pulp, and when he takes it out, the water from it drains through the wires and leaves **a thin film of the pulp** behind.

The deckle is now removed, and the sheet of pulp is turned over on to a pad of felt. A great many sheets are piled one on the other **with felt between each pair**, and then they are pressed **to squeeze out the water.**

When they are dry enough the felts are taken away, and we have **sheets of real paper**, except that it is more like **blotting paper** than anything else. Each sheet has to be dipped into **a solution of size**, and carefully dried, before it is fit to be written upon.

PART II.—MATERIALS USED IN WASHING

Lesson XXVII

DIRTY CLOTHES

The teacher should be provided, if possible, with one or two pictures showing costumes of past ages.

I. INTRODUCTION

COMMENCE by leading the children to compare, in a new sense, their frocks, jackets, cloaks, and other outer garments, with their underclothing. Elicit that these outer garments are worn continuously day after day for a long time, but that we always change our underclothing frequently and at regular intervals.

Why is it so necessary to change these under garments? Because they get dirty.

But these things are covered up by the rest of our clothing. How can they get dirty?

This will no doubt be a puzzling question. The children know from their own experience that their frocks and pinafores get soiled and dirty **with dirt from the outside,** *but they will hardly be prepared to say where the dirt can come from to soil their underclothing. Remind them once more of the* **perspiring work of the skin.** *Lead them to tell that, after we have exerted ourselves more than usual with either work or exercise, we notice* **little round drops of water** *standing on the skin—that these drops of water* **ooze through the skin,** *that we call them* **drops of sweat.**

Explain that, although we do not notice it, some of this moisture is **always oozing through the skin night and day.** *We call it* **perspiration.** *The harder we exert ourselves, whether in work or play, the more the skin perspires, and it is then that the moisture stands in* **drops of sweat** *all over the body. The body then feels* **quite wet.**

Explain that this perspiration or sweat is not merely water. It contains **bad, poisonous matter,** *which the skin throws off, so that it may not do harm inside the body.*

II. WASHING MATERIALS

What becomes of all this sweat or perspiration? It is **soaked up by our underclothing.**

Yes, if we perspire heavily, our under-garments get quite wet. But how is it that our clothing is able to soak up the perspiration in this way? Because it is made of **porous materials.**

What happens to these wet under-garments after a time? They get dry again.

How is this brought about? The heat from the body **changes the water into vapour**; that vapour passes away into the air, and leaves the body and the underclothing dry.

What is the best of all materials to wear next the skin? **Flannel.**

Why? Because flannel is **a bad conductor of heat.**

What does that mean? The flannel lets the perspiration pass away in vapour, but **it prevents the heat of the body from passing away with it.**

Why would not calico and linen do as well? They are **good conductors.**

They would let the bodily heat pass away as well as the perspiration.

How do you know that? Because linen and calico garments **always feel cold** when they get wet with perspiration. They strike cold and wet to the skin, and **are likely to give us a chill.**

Explain that it is **only the watery part of the perspiration** *that passes away. All the bad poisonous matter, which the skin throws off, is* **left behind on the clothes**; *and this in time would make them* **smell very bad.**

Remind them that men and women at their work, as well as children at their play, cannot avoid getting their hands and their clothing dirty if they handle dirty things. But impress upon them that **the dirt which comes out of the body in perspiration** *through the skin, is* **much worse than any outside dirt.**

In this way lead them to see that a frequent and regular **change of underclothing** *is necessary* **to get rid of our body dirt,** *as well as of the dirt and dust, which we pick up by contact with things around us.*

Impress upon them the truth that people cannot expect to be healthy and well if they neglect this duty.

Why are flannel, calico, and linen so suitable for underclothing? Because they are porous materials, and readily soak up the perspiration.

What happens to these things when they are put into the tub on washing-day? The **water soaks into them** because they are porous, and **the dirt is easily washed out** of them because they are porous; and so they are left clean and fit to wear again. The same property makes them easy to wash as well as suitable to wear.

III. WASHING-DAY

Elicit from what has been said that the cleanliness, health, and comfort of the family make washing-day **an important part of the household management.**

Excite the curiosity of the girls by telling that in the old times long ago **people had no washing-days.** *How could they manage without clean underclothing?*

Tell that they had no washing-day, **because they had no clothes to wash.** *In those days, five or six hundred years ago,* **cotton was unknown,** *and the* **little linen** *that was made was so costly that* **only the rich could afford to buy it.**

Picture the nobles and other wealthy people of those times in their fine clothing. They no doubt looked very grand, but they wore these things week after week, and **none of them**—*not even those next to the skin*—**were ever washed.**

The poor were even worse off still. Their clothing was made of **rough, coarse wool;** *and they wore the same garments night and day* **as long as they would hang together.** *Washing them was out of the question.*

Tell that, as a result of all this, thousands upon thousands of people were swept off every year **by fevers and other fearful diseases.**

Show a picture, or tell the story briefly, of **the Plague of London.** *Remind the children that this terrible visitation took place only a little over two hundred years ago, and that clothing materials had even then got to be much cheaper than they had been in the olden times.*

Explain that the sole cause of the pestilence lay in the **dirty habits of the people themselves. They had not yet learned the value of cleanliness** *either in themselves, their clothes, or their houses. They wore their underclothing till it was very dirty, and then instead of having the dirty garments washed at once, the custom was* **to pile them away for months together** *in some cupboard or closet out of sight, and let them wait there till washing-day, which usually came* **once** *or at most* **twice a year.**

Show that these heaps of dirty clothes were a **terrible danger to health,** *for they gave off* **foul, offensive smells,** *and the longer they were kept the more foul and offensive they became, till at last* **fever and pestilence** *broke out on all sides, and people were carried off in thousands.*

We have learned better now. In every well-managed household, **washing-day comes round** regularly every week, or at least every fortnight, and there are never any **heaps of dirty clothes tucked away in sly corners,** to poison the air and breed deadly diseases.

Lesson XXVIII

WATER

Provide for illustration two large bowls or basins, two or three tumblers, some loaf sugar, hot and cold water, some dirty greasy rags, some rain water and spring water, and two or three pieces of soap.

I. NATURE'S CLEANSER

MAKE the foregoing lesson the starting-point for the new one, and commence by leading the children to think about washing-day at home.

Call upon them to name some of the things which mother uses for washing the dirty clothes. In all probability they will mention such things as soap, soda, washing-powder, blue and starch, and omit water altogether.

Tell that there is something else much more important than all these—so important that there could be **no washing of any kind without it,** *and in this way lead them to think of* **water.**

Let us try now to find out how it is that water is so useful for washing and cleansing purposes.

1. **Hot and cold water.**—*Set two of the girls to wash*

pieces of dirty rag in separate bowls of hot and cold water, while the rest look on and note what takes place.

N.B.—No soap or soda is to be used for this.

Look at the water in the bowls and tell me what you notice. It is beginning to look dirty.

Why is this? Because the **dirt is being washed out** of the rags into the water.

Then what change do you expect to see in the rags themselves when they are taken out of the water? They will be clean.

Instruct the two girls to wring out both pieces of rag and hold them up before the class.

Are they clean? They are not clean; but they are cleaner than they were.

Do you notice any difference between the two pieces? Yes, **one looks cleaner than the other.**

Which is that? The one that was **washed in the hot water.**

Let us find out what all this means.

2. **Water a solvent.**

Drop a piece of lump sugar into a tumbler of cold water, and at the same time put several pieces into another tumbler of hot water. Stir both with a spoon, and call upon the children to explain what happens. This they will readily do, as the solvent powers of water have been dealt with in the earlier stages.

The sugar in both tumblers is disappearing. What has become of it? **It is being dissolved** in the water.

What do you mean by that? It is being **broken up** into very small particles, and **scattered** about through the water.

How could you prove this? By dipping a finger into the water and tasting it. **Every drop of the water would taste sweet,** because it contains some of the sugar.

As soon as all the sugar has disappeared in the hot water, call attention to the fact, and point out that, although only one piece was put into the cold water, that is not yet quite dissolved.

What do we learn from this? We learn that **hot water dissolves sugar better than cold water.**

Do you know any other substances that dissolve in water? **Salt, alum, lime,** and **soda.**

What do we say about water because it dissolves these things? We say that **water is a solvent** for sugar, salt, alum, lime, and soda.

3. **Water a solvent for dirt.**

Explain that **water** *is also a* **solvent for dirt**; *it made those pieces of rag clean* **by dissolving the dirt that was in them,** *and that dirt is now in the water itself.*

Lead the children to deduce, from what has been shown them, the reason why the one piece of rag was cleaner than the other after the washing.

Hot water dissolves more dirt (just as it dissolves more sugar) than cold water.

Remind them that mother always uses **hot water for washing the clothes,** *and she even boils most of the things in the copper, after they have been washed. Why does she do this?*

4. **Water not a solvent for grease.**

Lastly, give the two girls some rags which are not only dirty but **greasy as well,** *and set them to wash these, without soap or soda as before. Point out that with all their rubbing* **they cannot remove the grease,** *it remains fixed as it were to the rags.*

What does this mean? The water **cannot dissolve the grease.** Even the hot water is unable to do it. The grease, and the dirt in it, remain in the rags.

Now let us see what we have learned about the cleansing properties of water.

(*a*) It washes the clothes **by dissolving the dirt** that is in them.

(*b*) **Hot water dissolves more dirt,** and therefore leaves the clothes cleaner **than cold water.**

(*c*) The dirt which is dissolved and washed out of the clothes **makes the water itself dirty.** Hence it is necessary to frequently change the **dirty water for clean.** We could not expect to have clean clothes, if we washed one thing after another in the same dirty water.

(*d*) **Water is not a solvent for grease.**

II. HARD AND SOFT WATER

Empty the bowls, fill one with soft the other with hard water, give each girl a piece of soap, and set them to wash their hands, while the rest of the class observe what takes place.

In one case the soap **mixes with the water,** and covers the girl's hands with a white foam which we call **lather.** In the other the soap and water **refuse to mix at all**; the soap can be seen floating as a sort of scum on the top of the water, but there is **no lather.**

Explain that this water, which will not make a lather with soap, is called **hard water**; *the other which lathers easily is known as* **soft water.**

Instruct the girls next to take the dirty greasy rags, and wash them with soap in the two bowls, and as before let the class tell what they observe.

The **soft water** and the soap soon make **a lather** in one bowl, and as the girl rubs, the rag is seen **to get cleaner and cleaner.** The grease and dirt **are being dissolved** and washed out of it. The other girl rubs as hard, but she can make no change in the rag; it is **as dirty and greasy as ever.** The soap simply **curdles** and **floats on the top** of the water like scum. It **will not form** a lather; it **will not dissolve the grease** in the rag, because it is **hard water.**

III. RAIN-WATER, TAP-WATER, SPRING-WATER

Elicit from the children the sources of all the water we use, as follows:—

We catch the rain as it falls—this is **rain-water**; we draw water from the taps in our own houses—this we call **tap-water**; we pump or draw up water from wells—and this is known as **spring-water.**

Tell that **rain-water** *is always* **soft.** *It is the best to use for washing purposes. Why?* **Tap-water** *and* **spring-water** *are always* **hard**; *spring-water is much* **harder than**

tap-water. *Promise to explain more about this in the next lesson.*

Remind them that rain-water cannot always be got, and so most people have to use these hard waters for washing purposes.

But before this kind of water can be of any use for washing and cleansing **it must be made soft.** *Tell briefly how this is done.*

(1) By boiling the water.

Explain that this is one of the reasons why mother always boils the water on washing-day. **Boiled water is softer than cold water** *fresh from the tap.*

(2) By adding soap, soda, washing-powder, and other things to it.

Promise to explain more about these things in a later lesson.

Lesson XXIX

HARD AND SOFT WATER

Boil in readiness for the lesson two flasks of hard spring-water. Let one of them get cold. Provide also a similar flask of the same water unboiled, a "furred" kettle, the two basins used in the preceding lesson, and some soap.

I. Chalk and Lime

Produce the flask of unboiled water, and the one containing water which has been boiled and is now cooling down. Tell that some time before the lesson both were filled with cold, hard spring-water. Let the children feel them. One is quite cold still; the other is warm.

Explain that this latter flask has been standing over the Bunsen burner; the water in it has been boiling for some time.

Instruct them to look closely into the two flasks, and see whether they can detect any difference in the appearance of the water.

The cold unboiled water in one flask looks **clear and**

bright; the boiled water in the other has a **clouded, milky appearance,** especially near the bottom.

Produce the third flask now. Tell that the water in this one has been boiled too, but it has had time to get cold. While it was cooling down it had **the same clouded milky appearance** *as the water in the other flask, but it is now quite clear. What has happened to it?*

Point out the **thin white deposit** *or* **sediment** *at the bottom of the flask. Tell that this sediment is* **chalk,** *and explain that* **lime is the chief material** *from which chalk is made. There was* **lime in the water** *before it was boiled; there is some of it in this flask of clear bright cold water, although we cannot see it,* **because it is dissolved in the water.** *Tell that the chalk does not show itself* **till the water has been boiled**; *that the boiling in fact* **changes the soluble lime** *into* **insoluble chalk.** *It is the multitude of little particles of newly-formed chalk which at first give the boiled water its milky appearance. They are* **not soluble** *in the water, and hence* **they gradually sink to the bottom** *and form a deposit there as the water cools.*

N.B.—It is a difficult matter to make this intelligible to young children, who have no knowledge of chemistry. Hence the above explanation must suffice for the present.

The true reason for the deposit after boiling is that there are two carbonates of calcium. One is common chalk (carbonate of lime) which is insoluble in water, the other is a compound formed in presence of an excess of carbon di-oxide, and this is soluble in water. It is this soluble compound which originally exists in the spring-water, and when the excess of carbon di-oxide is driven off by boiling the water, chalk is left behind, and this being insoluble must sink to the bottom.

This brief explanation is intended simply to make a somewhat difficult point quite clear to the young teacher herself, and of course forms no part of her present lesson.

"FUR" IN THE KETTLE

Produce the **"furred" kettle** *now, remove the lid, and proceed to examine the inside. Call attention to the* **thick, hard, grayish-white crust** *all over the sides and bottom of the kettle. Tell that for want of a better name people call this crust* **the "fur,"** *and say* **the kettle is "furred."**

Show a new kettle, if possible, and point out that there is no "fur" on the inside of this; and then, by returning once more to the three flasks, lead the children to find out for themselves what it all means.

Commence with the flask of unboiled water, and elicit from the children that it contains lime, although we cannot see it.

Why are we unable to see the lime in the water? Because **it is dissolved.**

How did I make you see it? **By boiling the water.**

What took place then? The boiling **changed the lime into chalk,** and then we could see it.

Why could we see the chalk in the water? Because **it is insoluble.**

What became of the chalk? It floated about in the water in little particles, and at last **sank to the bottom** of the flask.

Now think of the "fur" in the kettle. Can you tell me at last what it really is? It is the **lime** of the water **changed into chalk by boiling.**

Pour out now the boiled and unboiled water from the two flasks into separate basins, taking care not to disturb the sediment from the former, and apply the soap test to both. Call upon the class to explain.

The unboiled water is **hard**; that which has been boiled is **soft—it makes a lather with soap.**

There is no lime in the boiled (or soft) water. The lime that was in it has been changed into chalk, and is **left behind in the flask.** All the lime remains in the unboiled (or hard) water. **It is the lime that makes the water hard.**

III. SOURCES OF SUPPLY

Lead the children next to consider the great importance of water in our every-day life.

Water forms our **daily drink**; whatever the particular drink may be it is made of water. It is therefore **one of the necessaries of life.** We also use it in **preparing** and **cooking our food.**

But besides all this, it is Nature's cleanser. We **wash and cleanse** our bodies, our clothes, and our houses with water; we use it for **flushing the drains,** and **cleansing the streets.**

It is essential too **for the life and growth of plants,** and it enters largely into **almost every manufacture.**

Elicit from the class that the water which we use for all these purposes is called **fresh water** *to distinguish it from the water of the ocean,* **which is salt**; *and tell that every drop of it originally* **falls in rain** *from the clouds.*

We have already learned that this water is not all alike—**some is hard, some soft.** How can this be, if it all comes from one source—the rain?

1. **Spring-water.**—*Remind the children that the water we boiled in the flasks just now was spring-water. Tell that* **all spring-water is hard.** *The hardness of that water was* **due to the lime which was dissolved in it.** *Where did the lime come from? Describe briefly the nature of a spring.*

We call it a spring **because the water springs** or bubbles up out of the earth.

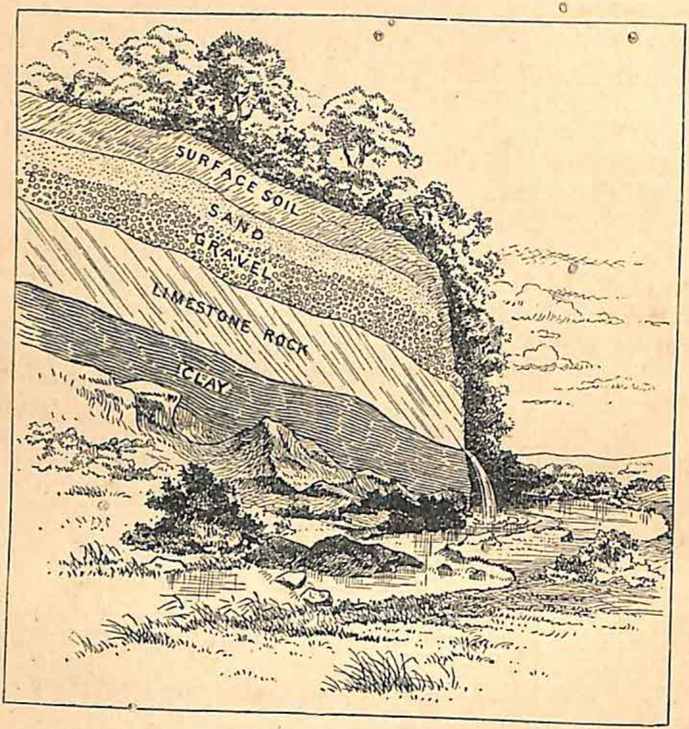
How did the water get into the earth? It fell as rain, and trickled through the soil and the rocks beneath the soil.

How can the rain sink into the earth? Because **the earth is porous.**

Draw a section of a hillside, showing the beds of porous rocks underlying the soil.

Point out the **impervious bed of clay** *beneath these, and tell what happens, as the water accumulates above the clay.*

Explain that the water as it trickles through the earth passes through **great beds of limestone**; *it* **dissolves some of this lime** *and carries it away. There was no lime in the rain as it fell—it was soft water; it is* **the lime in the spring-water** *that makes it hard.*



2. **Rain-water.**—We have yet to learn why rain is always soft water.

The rain comes from the clouds; but what makes the clouds? The **vapour which rises from the earth.**

I remember we once boiled some solutions of salt, sugar, and lime in little tin dishes over the flame of the Bunsen burner. Can you tell me what happened? The water passed away as vapour; the **salt, sugar,** and **lime remained behind** in the dish.

Explain that it is exactly the same with the evaporation that goes on all over the world. **Nothing but the pure water-vapour rises** *to form clouds; there is neither lime nor anything else in it, and so* **the rain** *which falls from the clouds* **is always soft water.**

This will also make it clear that, although most of the vapour rises from the salt water of the ocean, it is not salt itself, **because none of the salt rises with the vapour.**

3. **Tap-water.**—*Tell that the tap-water which is supplied to our houses* **comes mostly from rivers.** *The rivers rise as a rule in springs, but as the water flows along,* **it is exposed to the air,** *and the air itself* **helps to soften the water.** *Tap-water although hard* **is never so hard as spring-water** *for this reason.*

N.B.—*This can be dealt with better and more fully in a later stage.*

Lesson XXX

SOAP

Articles for illustration: a dirty bottle which has been used for holding oil, some soda crystals, alum, a kettle of hot water, a basin, a bottle of oil, a tallow candle, a knife, a small saucepan, the Bunsen burner, a tripod stand, specimens of fats and soaps, a few sticks of caustic potash. *N.B.*—The potash must be kept in a well-corked bottle, or it will rob the air of its moisture and rapidly disappear.

I. Oil and Water

Commence by calling attention to the dirty oil-bottle as follows:—

The bottle you see is covered with dirt and grease inside and out. Now suppose I wished to make it clean.

What should I do to get rid of all the dirt and oil? Wash it well with hot water.

Let one of the girls come to the front and wash it. Point out that, after all the washing, the bottle still **remains in the same dirty state.** *The dirt and grease still cling to the sides of it.*

Now put some pieces of soda into the hot water. While the soda is dissolving, elicit from the class all they can tell from their own simple observation, of its appearance, properties, and uses. It is **like alum in appearance,** *but it* **does not taste like alum.** *Alum has a sharp sour taste;* **soda tastes bitter.** *Mother uses soda on washing-day—it is often called* **washing-soda.**

When the soda is all dissolved, pour some of the solution into the bottle and shake it up for a minute or two. Then put the rest of the solution into a basin and wash the bottle in it. In a very short time it will be quite clean.

What has happened? The **soda and water have removed all the dirt and grease,** and left the bottle clean.

Remind the children that the hot water alone could not do this. Tell that **soda is a solvent for oil and grease** *of all kinds. It breaks up the grease into tiny particles and dissolves them, and then the* **dirt and grease** *as well* **mix** *with the water.* **Water will not dissolve fat and oil of any kind.**

II. Dissolved Oil Makes Soap

Let us have another experiment now. I have here a strong solution of soda. I will half-fill our bottle with the solution, add as much of this oil as it will hold, and then give it a good shaking.

What happens as I shake the bottle? The oil and the soda-water seem to be **mixing together.**

Why is this? Because the **soda is dissolving the oil.**

After shaking it well for a few minutes, stand the bottle on the table, and call upon the class to tell what they observe.

Lead them to tell that at first the clear oil floated on the top of the water. Why? Because it was lighter than the water.

Point out that now, after the mixture has settled, the water is still at the bottom, and that there is something floating on the top. But this is not oil; it is **oil dissolved in soda.**

Pour some of it out into the children's hands, and ask them to rub it in their hands.

Elicit that **it is not greasy and oily** *now;* **it feels soft and smooth, like soap.** *It has a soapy feel.*

Explain that it is really **a sort of soap**—*that we have been making soap in a simple way* **by dissolving oil in soda.**

III. How to Make Soap

Remind the children that soap of this kind would not be of much use, and then proceed with another experiment as follows:—

Stand the small saucepan over the flame of the Bunsen burner, and set one of the girls to shred a piece of tallow candle into it. As the tallow melts, pour some of the strong soda solution into the saucepan, a little at a time, with a pinch or two of salt, and let the mixture boil for some time.

As the boiling goes on, call attention to the peculiar, **spongy, yeast-like formation,** *which rises to the top of the water* **like a sort of scum,** *and floats there, and when it has boiled sufficiently, set it aside to cool.*

When it is cool enough to handle, remove this spongy matter, and show that it is a more or less **solid mass.** *It contains a considerable quantity of water, but this may be easily removed* **by squeezing it in the hand,** *and when that is done, pass it round for the children to examine.* **It is a piece of solid soap.** *Let one of the girls prove that it is* **actual soap,** *by using it to wash a dirty rag.*

I have made our piece of soap in this rough-and-ready way in order that you may understand how all the soap we use is made in the great soap factories. The fat is put into an **immense copper,** capable of holding several tons, and there carefully heated **till it melts.** This **liquid fat is then boiled,** and in the meantime the solution of soda, usually called **the lye,** is added a little at a time. As the mixture boils, a little salt is thrown in, and **the fat and the soda unite,** while the water passes off in steam.

All that remains is to ladle out the **thick liquid,** pour it into moulds, and leave it to cool. As it cools, it forms the **solid hard soap,** such as we use every day.

IV. MATERIALS FOR SOAP-MAKING

We made our soap of **oil** and **tallow,** but **many other kinds of fat** are used in the soap manufacture; and this explains why there are so many different kinds of soap.

Show specimens of the different fats used for this purpose.

Among the various kinds of fat used in soap-making are **tallow, lard, dripping** and other **kitchen stuff; linseed-oil, palm-oil, coconut oil,** and those fats which are commonly known as **fish oils,** but which are really obtained from the **whale** and **seal.**

Show the specimens of soap one by one, and describe each briefly.

1. **Yellow soap.**—This is the **best and purest** for general household purposes. During its preparation **a little resin** is put into the boiling liquid. **Palm-oil** is sometimes used for this purpose **instead of tallow.**

2. **Mottled soap.**—*Call attention to the peculiar appearance of this, and tell that it is due to the impurities in the materials. Sulphate of iron* **(green vitrol)** *is added to the boiling mixture, and the* **liquid is kept well stirred,** *while it is ladled out into the moulds. Contrast it with the specimen of*

3. **White or curd soap.**—*Tell that the liquid from which this is made* **is not stirred,** *and all the impurities are allowed* **to sink to the bottom,** *before it is ladled out.*

These white or curd soaps are afterwards melted down, mixed with some sort of perfume, and then **poured into moulds,** so as to make **cakes** or **tablets of fancy, toilet soaps.** *Show specimens.*

4. **Marine soap.**—This is the only soap that will **form a lather in salt water**; it is therefore used for washing purposes **on board ship** where of course fresh water is scarce. It is made from **coconut oil.**

5. **Bar soap.**—*Explain that the* **moulds** *or* **"frames,"** *in which the boiled liquor is left to cool, are* **large, square, wooden vessels** *capable of holding several hundred-weights. When it is sufficiently cooled down, the soap is taken out of the mould in a* **compact solid mass,** *and cut up, first into* **slabs,** *and then into* **bars,** *by means of a wire; and the name of the maker is stamped on each bar while it is still plastic.*

6. **Soft soap.**—*Call attention to the specimen, and show the reason for its name.*

It is very useful **for scouring purposes** of all sorts. It is made from **vegetable** and **fish oils,** and **potash** is used instead of soda.

Show some sticks of caustic potash. Let the children test it as they did the soda. Elicit from them that it has **the same bitter biting taste** *as soda; and show by experiment that it has* **the same action on grease and fat.**

Tell that **soda** *and* **potash** *are called* **alkalies,** *because of this. That will be quite sufficient for the present; they will be dealt with more fully in a later stage.*

Lesson XXXI

SODA

Provide for illustration a piece of soap, a lump of common salt, some soda-crystals, a greasy oil-bottle, some cabbage leaves, an old iron fire-shovel, and some cotton, linen, and flannel articles which have been spoiled by the action of soda.

I. RECAPITULATION

Show the piece of soap, and proceed in some such way as this:—

What are the two essential materials of which this soap is made? **Fat** and **soda.**

How is the soda mixed with the fat? It is **made into a solution** called **lye,** and boiled with the fat.

How does the soda act upon the fat? The **soda dissolves the fat,** and then the two things unite together **to form the new substance—soap.**

What name do we give to those things, which we use to dissolve fat and change it into soap? We call them **alkalies.**

What other alkali is used in soap-making besides soda? **Potash.**

What useful purpose do these alkalies serve in washing? They **make** the **hard water soft**; and they also **act as a solvent for grease.**

What makes the water hard? **Lime and other mineral matters** which the water dissolves out of the rocks, as it makes its way through the earth.

Why is it necessary to make hard water soft for washing purposes? Because **grease will not dissolve in hard water.** Even the soap itself is unable to make a lather in hard water; it **curdles and floats like a scum** on the top of the water.

Explain the effect of the soda on the hard water thus:—As the soda dissolves in the water, it seizes hold of the lime and other matters in it, and **unites with them** *to form something entirely different; and in doing this it makes the water soft,* **because it destroys the power which those things had of hardening it.**

Remind the children that **boiling also softens hard water**; *but it does its work* **by changing the lime into chalk,** *which is insoluble and therefore sinks to the bottom of the kettle.*

Why is a solvent for grease necessary in washing? Because we cannot wash out the dirt from any article, **unless we wash out the grease** to which most of the dirt sticks. **Water is not a solvent for grease,** but the **soda unites with the grease and makes it soluble,** and then the water is able to wash it all away and the dirt with it.

This will be made perfectly clear by referring once more to the dirty, greasy rag which was washed clean with the help of soap. It was the soda in the soap that did the work **by first dissolving all the grease** *out of the rag, and then the particles of dirt were left free for the water to dissolve and carry away.*

II. SODA—WHAT IT IS

Show a lump of common **salt** *and some* **soda crystals** *side by side.*

Point out to begin with that the two substances **are not at all alike in appearance.**

Then let the children test the two things by putting them to their tongue, and they will find them **very different in taste.**

Lastly show, by the now familiar illustration with the greasy bottle, that **salt is not a solvent for fat.** *It will not mix with the fatty oil, and dissolve it as soda does;* **it would not unite with fat of any sort to make soap.**

Salt and soda, in all these respects, are totally different substances, and yet in spite of this, **soda is actually made from salt.**

Salt is a mineral; it is obtained from mines and salt-springs in the ground. As soda is made from salt, **that too must be a mineral substance,** although it is never found in the ground as we find salt.

N.B.—These young children need not be troubled with the details of the soda manufacture; it will be quite sufficient for them to know the source of the material.

Soda was formerly made **from the mineral ash** left behind after burning a kind of **sea-weed**; but it can now be made much more easily and cheaply from salt itself, so nearly all the soda we use **is made from salt.**

The idea of a mineral ash in plants might be made quite clear by burning some common vegetable matter—a few cabbage leaves will do as well as anything—in an old shovel over a red-hot fire. When the burning is all over, there will be something left behind in the shovel, **which will not burn.** *This is* **the mineral ash**; *there is* **mineral ash** *of some sort* **in every plant.**

Potash, the other alkali used in making soap, is still obtained **by burning vegetable matter,** and steeping the mineral ashes in water.

III. The Cleansing Power of Soda

Lead the children next to think of the constant washing, cleansing, scrubbing, and scouring operations, which form so large a part of the daily routine in every household; and then point out the importance of a plentiful use of soap and soda in almost all of them. Without them **grease and the dirt that clings to it could never be removed,** *nothing would be clean.*

Remind them too of the necessity of personal cleanliness. Our bodies must be washed frequently **to remove the perspiration** *and other matters, which are constantly oozing out from the skin.* **Water alone would not do this.**

We use soap for the purpose **because the alkali** *in it* **is**

able to lay hold of the greasy part of this perspiration *and dissolve it, and then the water can wash it all away, and the dirt with it, and so leave our bodies quite clean.*

Elicit next that the principal object of washing our clothing is **to get rid of this same greasy, unwholesome, bodily dirt,** *which is soaked up by our under garments, as it oozes through the skin. The clothes would soon begin to smell foul and unpleasant, if we wore them too long.*

Soap and soda are necessary for this; *without them it would be impossible to get rid of the grease and dirt.*

Point out next that, as most of the water we use is more or less hard, **the first business on washing-day is to soften it.**

Explain that this is always done by boiling the water and dissolving some of the soda crystals in it. Mother would never think of commencing her washing without doing this, for **it would be very wasteful,** *if she trusted to the soap alone. She would have to rub the soap on the dirty things for a very long time, before she could see any result for her work.*

Why is this? The soap would only **curdle in the hard water,** and float like scum on the top.

Explain that all this time the soap, or rather the soda in it, would be used up **in destroying the power of the lime** *and other things that make the water hard. She would have, in other words, to* **use up a great deal of her soap to make the water soft,** *and until this was done, there would be none to spare for making a lather.*

This means that she would be unable to remove either dirt or grease from any of the articles in the tub, until the hard water had been made soft. Therefore, instead of wasting her soap, **she first softens the water with soda,** *and then the soap is able at once to do its proper work.*

IV. THE DESTRUCTIVE POWER OF SODA

Point out that, in spite of its importance as a cleansing material, **soda has to be used with much care** *in the laundry, for it is very powerful in its action.*

1. It is very **destructive** to the **fibre of cotton and linen.**

2. It **spoils** the loose, open texture of **flannel,** and makes it **thick and matted.**

3. It turns **white linen and calico yellow.**

4. It **destroys the colours** in cotton prints.

Show, if possible, specimens of these materials which have actually been spoiled in the ways indicated by the improper use of soda.

5. It is very **irritating and injurious to the skin.**

The washerwoman's hands will afford a good illustration of the action of soda on the skin. Remind the children that we never use soda for washing ourselves. Even soap which contains too much soda is highly injurious to the skin.

Lesson XXXII

OTHER WASHING MATERIALS

The teacher should be provided with a packet of washing-powder, a basin, some water, a piece of soap, some borax, chloride of lime, a blue-bag, a ball of blue, pictures of the indigo plant, and the common pea, some common laundry starch, some flour in a muslin bag for experiment, a tumbler.

I. Washing Powders

Empty a packet of one of the common **washing-powders** *into a basin. Tell what it is, and explain its importance in the laundry, as another very valuable washing and cleansing aid.*

Pour some water on the powder to show that it is **readily soluble.**

Let the children dip their fingers into the solution, and elicit from them that it has **the same smooth, soapy feel,** *as they have become familiar with in the solution of soda.*

Let them smell it, and taste it by dipping the tip of their *finger into it. They will at once detect* **the soapy smell,** *and* **the peculiar taste** *of soda.*

Explain that this is because soda always forms one of the most important materials from which these washing powders are made. Give one of the girls a piece of soap next, and set her to wash her hands in the basin. Notice how easily and quickly a lather forms on the water.

What does this tell us? It tells us that the water in the basin is **soft water.**

What else could we have used to soften the water instead of that washing-powder? **Soda.**

But I have already told you that soda is one of the principal materials in this washing-powder.

Why not use soda by itself then? Let us try to find out. We shall do this best by examining the other materials of which the washing-powder is made.

Show some **borax** *in a saucer. Tell that this is one of those materials. Let the children examine it, and lead them to tell that it is* **a white powder,** *with* **a smooth, soapy feel,** *and a taste and smell* **resembling the taste and smell of soda.** *Show too that it is* **easily soluble in water.**

This white powder is borax. It is a **mineral substance,** and is found in a natural state on the shores of certain lakes, just as salt is found on the surface of the earth in some parts of the world.

Borax has wonderful **cleansing properties,** and helps **to whiten the clothes** and keep them a good colour.

Washing-powders of all sorts contain **soda and borax,** together with more or less **lime,** or **chloride of lime.**

Remind the children of the earlier lesson on bleaching, and lead them to tell the use of the chloride of lime **for whitening or bleaching purposes.** *Call for its other name* **bleaching-powder.**

Point out now that in these washing-powders we have two materials, borax and bleaching-powder, **for the express purpose of keeping the clothes white.**

Why is this necessary? Because **the soda helps to make the things yellow.**

The borax and bleaching-powder **destroy the yellow colour,** which the soda gives to the clothes, and so keep them white.

Explain that many people object to use washing-powders, which contain lime or chloride of lime, because these things are **even more destructive** *than soda* **to the fibre of cotton and linen materials.** *They prefer to use soap and soda alone, and to employ some other means of getting rid of the bad colour which the soda gives.*

II. BLUE

1. **Its use.**

Show the blue-bag. Lead the children to tell what it is, and how it is used in the laundry.

The bag itself you can see is made of flannel; but what have we inside the bag? A **ball of blue.** *Show a ball fresh from the shop.*

How is this blue-bag used on washing-day? It is dipped into a tub of clear cold water several times, till some of the blue colour comes out into the water, and **makes the water blue.** In other words, what does the water do to the substance in the bag? **It dissolves it.**

Dissolve some of the blue from the bag in a small basin of water, so as to make the water very blue. Then dip a piece of white calico into it, wring it out and hold it up before the class.

What have we done to the calico? We have **dyed it blue.**

Then what shall we call the substance that has given the calico this new colour? **A dye material.**

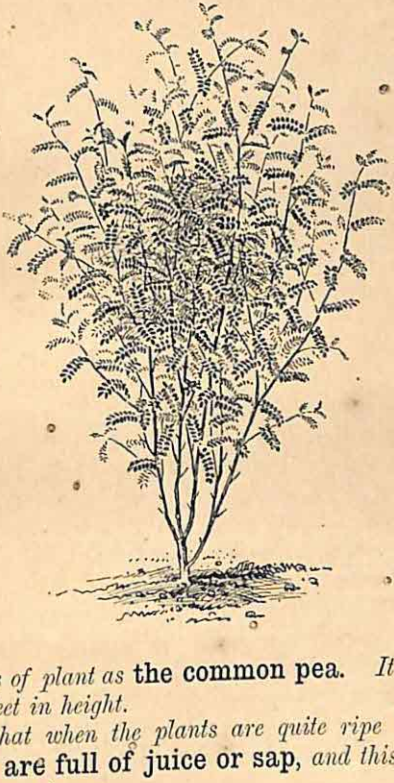
Point out that the object of the blue-bag in the laundry is **not to make the things blue,** *but only to* **destroy the yellow tint,** *which the soda gives them. Hence we use only sufficient of the blue colouring matter* **to make the water a very pale blue.**

You told me just now that the blue ball in the bag is a dye material. So it is; it is made of the blue dye—

indigo—which we have already heard of in connection with the work of dyeing.

2. **What it is.** Indigo is **a vegetable substance.** It is made from the **juice of a plant,** called the indigo-plant, which is grown in India.

Show a picture of the plant. Point out that it belongs to



the same class of plant as **the common pea.** *It grows from three to five feet in height.*

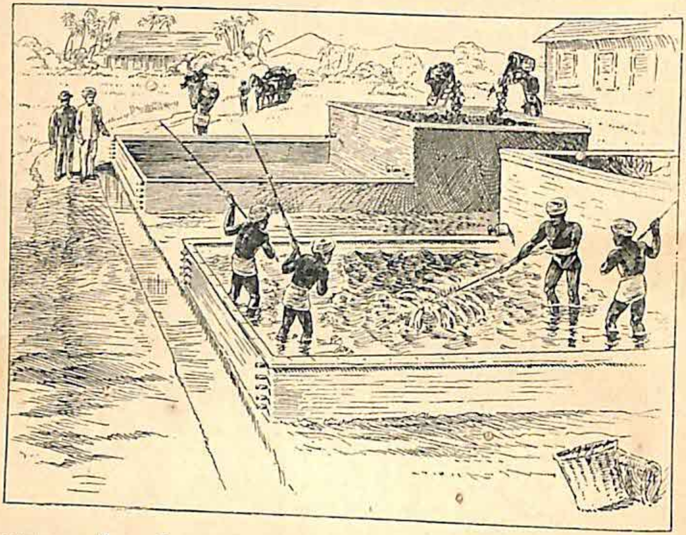
Explain that when the plants are quite ripe **the stems and leaves are full of juice or sap,** *and this is the time to cut them down for use.*

3. **How it is made.** The plants are thrown into great tanks of water, as soon as they are cut down, and left there to steep.

Elicit from the class, by referring them to past experiments, what must be the result of this soaking. **The juice** from the stem and leaves **oozes out into the water.**

The liquid left in the tanks, after the stems and leaves have all been removed, is at first **a bright yellow colour.**

The yellow liquid is then lashed with long bamboo sticks, so as to expose it to the air, and while the beating goes on, the colour changes, **first to a green, then to a rich dark blue.**



It is afterwards left to settle. The liquid becomes quite clear at the top, and is drained off, leaving **a muddy deposit** at the bottom.

This is boiled to get rid of the water; and then nothing is left but **a solid cake** of an intensely blue colour, which supplies material not only for **the blue-bag,** but also **for dyeing purposes.**

III. Starch

Show some laundry starch. Lead the children to tell its uses. Remind them of their earlier lessons, and elicit from them all they can tell of the nature and source of the material.

Lead them to tell that the starch which we use for food and this laundry starch **are precisely the same material.**

Let one of the girls prepare some starch before the class in the old familiar way as shown in the earlier lessons. It would perhaps take too long to collect and dry the starch. Therefore, after seeing the deposit form at the bottom of the glass, show some which has been prepared and dried beforehand.

Elicit that starch is obtained from all the corn grains, and from potatoes. The best starch for laundry purposes **is made from rice.**

STANDARD IV

SECTION I.—FOOD

PART I.—FOOD IN THE BODY

PART II.—SOURCES OF FOOD

SECTION II.—CLOTHING

SECTION III.—WASHING

STANDARD IV

Lesson I

HORSE AND STEAM-ENGINE

Provide for illustration pictures of a horse and a locomotive. A large sheet of stout brown paper will also be required.

I. INTRODUCTION

COMMENCE by picturing to the class a powerful horse dragging a heavily laden waggon along the road. Notice how he tugs and strains and snorts and puffs—it is hard work.

Lead the children to tell that on another kind of road—the rail-road—we use another kind of horse for drawing heavy loads; that this horse is not a living animal, but a steam-engine. We call it a locomotive engine. Tell that people often call it the iron horse, because it is made of iron and steel; and it is so powerful that it can draw, not one waggon or carriage, but a great number linked together—a line or train of carriages. Show a picture of the locomotive.

The horse and the steam-engine both work. Let us try to find out how they get the strength which enables them to work.

Suppose we begin with the engine.

II. BOTH REQUIRE FOOD

What must the driver do when he wants his iron horse to work?

Call attention to the boiler and the great furnace beneath it. Explain that without these the rods and wheels of the engine would be quite useless.

The man fills the boiler with water, and makes a fire in the grate. **He must feed his iron horse with water and fire,** if he wishes him to work, and the more work he wants from him **the more food he must give him.**

But what sort of food does he give this horse? **Coal.**

Why does he not shovel sand into the furnace instead of coal? Because **sand would not burn**; it would put the fire out.

What would happen if the man forgot to feed the furnace? The fire would die out, and **the engine would stop its work.**

Tell that it would be just as bad if he overloaded it with too much, for this would **choke the fire** *so that it would not burn. If the engine is to do its proper work, its furnace must be fed* **with the proper food**—*coal,—and* **in proper quantities.**

Now let us leave the engine and think of the horse.

In what respect is the horse like the steam-engine? The **horse requires food from time to time,** just as the engine fire requires coal.

What would happen to the horse if he were kept without food? He would lose his strength; he would be unable to work; he would soon die.

It is plain therefore that **food is to the horse what fuel is to the engine.**

III. Both require Air

If there is a fire burning in the schoolroom, close up the front of the fireplace, nearly to the bottom bar of the grate, with a board, or with a sheet of brown paper stretched across, so as to increase the draught, and let one of the girls hold a piece of thin paper lightly in front of the opening. The paper will be instantly drawn in towards the fire. Explain this.

The fuel in the fireplace **cannot burn without air.**

As it burns air is always rushing in through the bars in front; the more fiercely the fire burns **the greater is the rush of air** into it.

Tell that it is exactly the same with the engine furnace. Picture it like a greedy giant roaring hoarsely with satisfaction each time a fresh shovelful of coal is thrown in. It is only **the air rushing in** *through the grating* **to make the fuel burn.**

Turn now to the horse. Tell how hard he breathes as he tugs along with his heavy load. Like the engine furnace **he must have air,** *for the food which he eats must be burned up inside his body, and* **it cannot burn without air.**

The horse and the engine are alike in this respect too. **Both require air** to keep their fires going. **The horse breathes in air through his mouth and nostrils,** just as the engine furnace draws in air through the grating. It is for the same purpose in both cases.

IV. WHAT FOOD AND AIR DO

Let us now go back to the engine.

What is the object of that roaring fire in the engine furnace? To boil the water in the great boiler.

What happens to the water when it is boiled? It changes into steam.

What is the use of that? **The steam tries to get away**—to escape from the boiler—and in doing this **sets the machinery going.**

In this way show that if there was **no steam** *there could be* **no work done.** *The* **burning of the fuel** *in the furnace* **makes the steam,** *and the steam does the work. Therefore, after all, it is* **the fuel that does it.**

Some of you have perhaps touched a horse's body. If so, you can tell me how it felt. It felt **warm.**

We have a special name for all animals whose bodies feel warm. What is it? We call them **warm-blooded animals.**

Can you tell me now why the horse and all such animals always feel warm? **The burning of the food** inside them **makes them warm.**

Explain that just as it is heat which produces steam to keep the engine at work, so it is heat—**the heat of the burning food**—*which produces* **the force** (*strength and energy*) **to make the horse work.** *Therefore in this point again the horse and the engine are alike.*

V. HORSE AND MAN

Suppose we leave the steam-engine now, and compare the horse with a man.

Elicit from the children, step by step, that the man and the horse are alike, in that both work, both require food to eat and air to breathe, both have warm bodies, and both get their strength or energy from the heat of their burning food. With regard to the work, point out that children in their way work as hard as men and women. Their romps and games call for the exercise of a great deal of energy, and this, as well as the strength which enables a man to do his work, can only be supplied **by the heat which comes from the burning up of the food** *that is eaten.*

Lead them to tell that their **breathing** *becomes* **more and more rapid** *as they exert themselves in their play. Explain that their internal fires are then* **burning more fiercely** *than usual, and require more air.*

Prove that this is the case because they not only **breathe harder,** *but their* **bodies get hot all over** *at such times.*

These bodies of ours are very wonderful machines. We ought to know how to take care of them, and therefore in this new course of lessons we shall begin by learning all we can about them.

Lesson II

THE LIVING ENGINE

For illustration provide a well-worn dinner knife, a hen's egg, a kettle of boiling water, a cup or a tumbler, some grains of corn.

I. Work means Wear

Show a well-worn, steel implement of some sort—a knife will do as well as anything. Elicit that the knife was not always in this state—that it has been worn away with the work it has done. Compare it with a new knife of a similar kind.

Work wears everything away in time. It even wears away those **great steam-engines** we were speaking about the other day. The time will come when those powerful iron horses will be **so worn away with their work** that they will be of no further use. They will be sold for old iron then.

But we will leave the steam-engine now, and think about those wonderful engines—our own bodies.

How do you yourselves feel just before school is over for the day? We **feel tired of lessons.**

You go out, and romp and play for a long time, but when the play is over how do you feel then? We feel quite as **tired with play then.**

What does father like to do when he comes home from work? He likes to rest quietly.

Why? Because he is **tired with his hard work.**

Explain that, like the steam-engine, **we ourselves cannot work without wearing away.** *Our bodies are not mere rods and wheels of steel; they are* **living engines capable of feeling,** *and this tired sensation comes over us, to tell us that* **the body is weakened** *by the loss of some of its* *substance, which has been* **worn away by the work** *we have been doing.*

Point out that even the great powerful horse requires rest after his work, for he **feels fatigue** *just as we do. Every tug he gives at the heavy load behind him* **wears out and destroys some part of his body,** *and makes him feel tired.*

These living machines—the horse's body and our own—were made for work, but **as they work they wear out.** Our bodies are constantly wearing out every minute of our lives.

Every act of our daily life—the movement even of a finger, the flashing of a single thought through the brain, or the blinking of an eyelid—destroys some of the substance of the body. Work of any kind, in any part of the body, means **wear and tear.**

II. THE LIVING ENGINE REPAIRS ITSELF

Point out that with all this work and waste constantly going on in the body, we should naturally expect to find people getting thinner and thinner every day of their lives. This, however, is not the case, for in spite of their work men and women **alter very little** *either in appearance, or in* **size and weight** *for years.*

What does that prove? There must be some way of making up for what is lost.

Explain that in every part of the body there is not only constant wear and waste, but also **constant repair** *going on. Bit by bit, every part of the body—***muscle, brain, bone** *—is not only worn away and destroyed by the work done, but* **as it is destroyed, it is built up again** *in its original form.*

If I prick myself in any part of my body what happens? **Blood will flow out.**

What do we learn from this? There must be blood in every part of the body.

Tell that it is so. Blood flows through every part of the body, and it is the **blood that builds up what has been**

worn away. *The blood has in it* **all the materials** *necessary* **for this building work,** *and it always leaves these materials just where they are wanted.*

How do we feel when we have rested after our work? We feel refreshed; that tired feeling passes away.

Why is this? I will tell you. The blood has been at work carrying **new materials for building up again what was worn away** with the work, and the body no longer feels the loss.

Now think for a moment, and you will easily be able to describe another feeling which comes over us when we have been working. What is it? We feel **hungry and thirsty.**

What do we do then? We eat and drink.

Explain that just as the tired feeling tells us that some part of our body has been wearing out and **must be built up again,** *so the feeling of hunger and thirst tells us that the* **blood itself has been giving up materials** *for this repairing work, and* **requires to be renewed.**

We eat and drink, and the feeling of hunger and thirst passes away, as well as the tired, weary sensation.

Think of this, and perhaps you will be able to tell me where the blood gets its repairing materials from. It must get them **from our food and drink.**

Lead the children from this to point out the double purpose of food. It provides **a sort of fuel,** *which burns in the body and* **produces heat and force** *to make the body work; and it also provides* **materials for building up** *all those parts which have been worn away with the work done.*

III. THE LIVING ENGINE GROWS

Lead the children to compare the steam-engine and the horse once more.

Elicit from them that both are complete machines from the first; that the engine will practically remain the same as it is now till it is worn out; but that the horse commences life **as a**

baby animal, *and* **grows day by day,** *till it reaches its full size.*

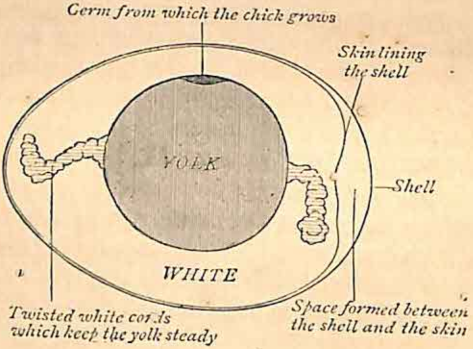
Lead them to tell that we ourselves are like the horse in this respect; we begin life as babies, **we grow up into men and women.**

What is it that makes our bodies, and the bodies of all animals, grow big and strong? I will show you.

Produce the hen's egg. The earlier lessons have made it too familiar to need any description here. Elicit from the class that the hen, in common with all other birds, lays eggs; that the mother bird if left to herself would sit upon the eggs and keep them warm; and that in course of time **a real live chicken** *would come out of the shell. We should then say that the egg* **had been hatched.**

Break the egg in a cup, and call attention to the contents of the shell.

The children will readily point out the clear, sticky liquid, which they know as the **white of egg,** *and the round yellow ball*—**the yolk**—*which floats in it.*


Germ from which the chick grows
Skin lining the shell
YOLK
Shell
WHITE
Twisted white cords which keep the yolk steady
Space formed between the shell and the skin

This liquid is not white as we look at it in the cup. Why then do we call it white of egg? **It becomes white** when it is boiled.

Pour a little of the clear liquid into boiling water. It at once changes into a **white opaque solid substance.** *This* *will remind the children of what they saw in the former lesson.*

Tell the name—**albumen**—*now, and give the reason for this name*—**albus** = *Latin for* **white. Albumen** *is* **white of egg.**

Notice next the **little round spot** *in the yolk. Tell that this spot is* **the germ,** *from which the young chicken would have grown if the egg had been hatched. Everything else in the egg is simply* **a store of food** *laid up for the little thing to feed upon. Compare the egg with the germinating* **grain of wheat.**

Tell how in each case the tiny germ absorbs the food store little by little **to build up its own body.**

When the store of food in the egg is all gone, the little thing breaks the shell and comes out—**a living chick.** with flesh and bones, feathers, beak, **every part of its body perfectly formed.**

If we take it in our hand, it **feels warm,** and it shows, by its struggles to get free, that it has a certain amount of **strength.**

Now all these things—the **materials for building** up its body, as well as its **warmth** and **strength**—all come **from the food,** which it takes while it is in the egg-shell.

Picture the same chick as it grows day by day, till at last it is a hen as big as its mother. Explain that the food which it eats, after it is able to run about and seek its own living, does it all; and then proceed to show that we ourselves and all other animals grow in precisely the same way.

It is food which little by little changes the small, weak body of the baby into the big strong body of the man.

Now let us see what we have learned about food and its work.

1. It **provides fuel** to burn in our bodies, and **so keeps us warm.**

2. It **gives us power** to work, and play, and run about.

3. It **builds up our small bodies** when we are young, so that they grow big.

4. It **repairs the waste** caused by the work we do all through our lives.

Lesson III

THE BODY AND ITS WORK

The teacher should be provided with good wall-sheets of the human skeleton, the brain and nerves, and the circulation. Pictures showing the skeletons of a horse, a rabbit, a bird, and a fish would also be useful. A living snail or a slug would serve to illustrate the soft-bodied animals.

I. THE BONES

WE are going to learn something more about those wonderful machines—our bodies—to-day. We must find out how they do their wonderful work.

Bring one of the girls to the front, and commence by calling attention to the **hard, solid substance,** *which can be felt under the flesh in her hands, arms, and head.*

This hard, firm, solid part of the body is **bone.** There are upwards of **200 distinct and separate bones** of various shapes and sizes in the body.

These bones form the **framework** on which the body is built. We call it **the skeleton.**

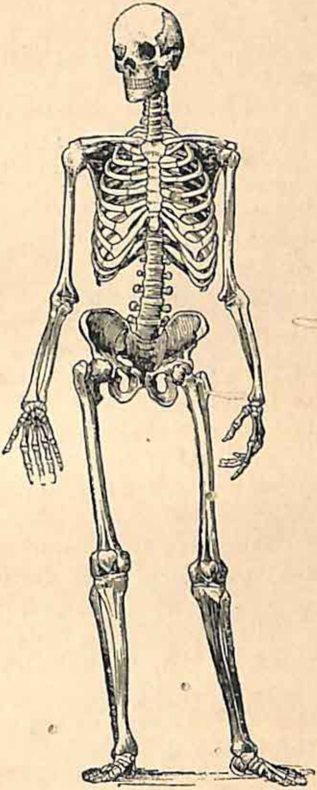
Show the wall-sheet picture of the skeleton, and point out that it is the skeleton or bony framework which **determines the shape** *of the body.*

This fact would be made quite clear to the children if pictures of other skeletons—say those of a **horse,** *a* **rabbit,** *a* **bird,** *and a* **fish**—*could be shown.*

In each case the **skeleton** *itself* **suggests** *the* **well-known shape** *of the individual body.*

Tell that there is a class of animals which have **no bony framework,** *or skeleton. We call them* **soft-bodied animals.** *Show pictures of some of these, and point out that* *most of them have a* **strong, hard shell covering** *as a protection for their otherwise defenceless bodies.*

This will lead the children to deduce for themselves another important purpose of the bony skeleton in their own body.



The hard firm bones **support the softer fleshy parts,** and so give strength and solidity to the whole body.

Call attention to the **strong, pillar-like bones** *of the legs, which support the body upright on the feet; and then tell of the strong* **back-bone** *which continues this support upwards. Point them out on the diagram.*

Notice next that the bones of the skull are fixed and immovable; they form a **hollow box or case.** *But most of the bones in the body are* **jointed together** *in such a way, that* **they can move** *one upon the other.*

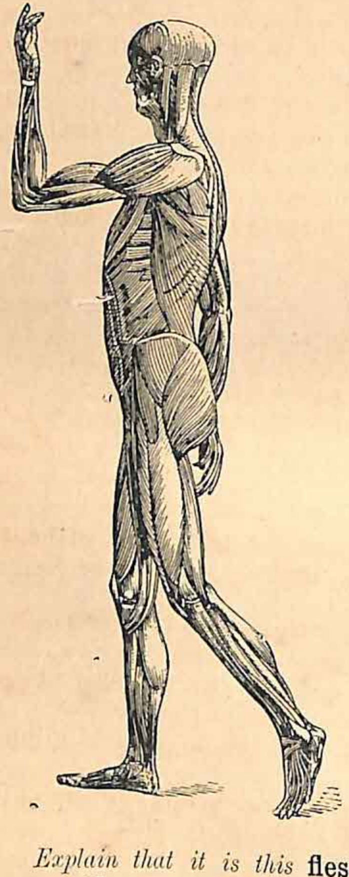
Put the girl through a few movements — such as opening and closing the hand, bending and straightening the elbow and knee, swinging the arms round in a circle, and moving the head up and down, and from side to side.

Point out that each of these movements—every movement we make—is brought about by the bones. **Without a bony skeleton such movements would be impossible.**

II. The Muscles

Let the girl bare her arm. Compare the round, shapely limb with the bony framework as shown on the wall-sheet.

Notice that the bones in the skeleton are **small in the middle** *and swollen into a sort of* **knob at the extremities,** *so as to form the joints.*



The arm itself, however, is **largest in the middle** *and gradually becomes small towards the wrist. It is the* **flesh which gives roundness** *and beauty to the body.*

Tell that if the white skin all over the body were stripped off, **the red flesh** *would be seen beneath.* **This red flesh is muscle.**

Lead the children to tell that there is more of this flesh or muscle in some parts of the body than in others. Why is that?

Set the girl in front to draw up her forearm slowly, and as she does it let another girl place her hand on the upper part of the same arm above the elbow.

What did you notice? The flesh in the top of the arm **swelled up** as the arm moved.

Explain that it is this **flesh** *or* **muscle** *which actually* **moves the arm.**

The bones themselves could not move without the muscles. **Every movement** *of every bone of the body is brought about* **by the muscles.**

Which parts of the body have most movement? The **limbs.**

Name some part of the body which does not move at all, but is fixed and immovable. The skull.

Now think of your own bodies, and compare the thin layer of flesh on the skull with the **thick solid muscles** of the **arms and legs.**

Wherever the greatest power of movement is required there we find the largest and strongest muscles. You have only to think of the work which the legs and arms have to do, and you will easily understand why their muscles are placed in **solid-looking masses round the bones.**

III. THE NERVES

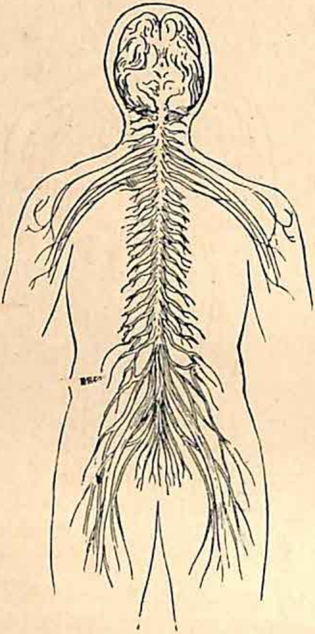
Picture to the class some poor paralytic sufferer. He lies helpless on his bed: he is unable perhaps to move a limb. Yet this is not the fault of either the bones or the muscles of those limbs. What can it mean?

Tell that just as the bones are unable to move without the muscles, so the muscles themselves **are powerless without the nerves.** *The man lies helpless because his nerves no longer do their proper work.*

Put the girl through one or two movements at the word of command. Point out that her nerves help her to hear the order as it is given, and **they then make the muscles obey.** *Whenever we wish even to lift our hand or turn our head, it is the* **nerves** *that* **make the muscles do their bidding.** *But what are the nerves?*

Show the large wall-sheet of the **brain** *and* **spinal-cord,** *or failing the picture sketch the thing on the black-board.*

Describe briefly the brain, lodged in the hollow box of the *skull. This is the* **centre of the nervous system.** *Point out the* **long white cord,** *which passes out through a hole in the bottom of the box, and stretches downwards through the middle of the long string of bones which form the* **backbone or spine.** *It is really* **part of the brain.**



Tell its name—the **spinal-cord.**

Notice next the long, **silvery-white threads,** *which stretch out in every direction, some from the brain and some from the spinal-cord.*

These are the **nerves.**

Tell that some of the nerves from the brain go to the **ear,** *some to the* **eye,** *some to the* **nose,** *some to the* **tongue,** *and some to the* **skin.** *It is by means of these that we are able to* **hear, see, smell, taste** *and* **feel** *things around us. We call these powers the* **five senses.**

Other nerves spread themselves among the muscles of the body. They are the **foremen** *or* **overseers,** *which* **make the muscles do their work.**

IV. THE BLOOD

Refer to the preceding lesson, and lead the children to tell what they can of the blood, as the **stream which is constantly flowing** *through the body,* **laden with nourishment** *which it gets from the food.*

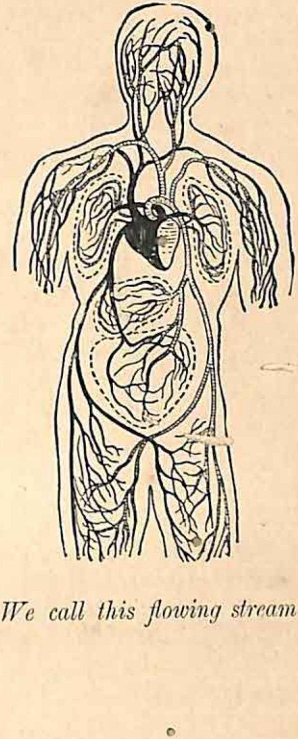
Show or sketch a diagram of the circulation.

Point out that this stream is carried through the body **in pipes,** *which we call* **blood vessels.**

Call attention to the heart—the **centre of this flowing stream.**

It is a **pump.** It pumps the blood along through the pipes.

Let the girls feel the beating of each others' hearts. **The pump is at work.** *Remind them that* **this pump never stops** *for a single instant all our life. The moment it stops we die.*



Point out that **the heart pumps the blood** *through the body, along one set of blood-vessels; that it is collected up by another set; and that these carry it back again to the heart. It is carried in this way* **round and round** *the body. We call this flowing stream the* **circulation of the blood.**

Lesson IV

MATERIALS FOR THE BODY

Articles required for illustration:—a shank bone properly cleaned and prepared, two other bones,—one of which has been burned in a clear red fire, the other steeped in dilute muriatic acid,—a bone fresh from the butcher's shop, showing the blood in it, a basin of cold jelly which has been made by boiling some bones.

I. INTRODUCTION

COMMENCE by eliciting from the children all they can tell of the repairing work of the blood. It flows through every part of the body laden with materials for repairing whatever has been worn out.

Lead them to tell that we always mend things with the materials of which they are made. We should use **a piece of cloth** *to mend a cloth coat;* **leather** *to mend boots;* **wood** *to mend a table, and so on. Leather and wood are useless for repairing the coat, and cloth and leather would be equally useless for mending the table.*

Explain that, in like manner, the body itself can be mended **only with the proper materials.**

The blood carries in its stream **all these repairing materials,** and it leaves them just where they are wanted. To the muscles it gives the very materials required **for making muscle**; to the bones it gives others **for making bone**; to the brain it gives what is necessary **for making nerve matter.**

But it never leaves bone-making materials for building up muscle or brain; nor does it take to the ear what is wanted for the eye. It never makes mistakes.

We must first learn something of the materials which make up the body itself, and then we shall be in a position to examine the materials which the blood carries for its repairing work.

II. MUSCLE OR FLESH

Let us begin with muscle. What do you understand by the muscles of the body? The muscles are **the red flesh,** which covers the bones.

What is the work of the muscles? **The muscles move the bones.**

Picture to the class a joint of beef hanging in the butcher's *shop, or better still, have an actual joint of meat in a dish for inspection if possible. This lean flesh is muscle.*

Show that the muscle (or flesh) is closely attached to the bones, and lead the children to tell that, when the animal was alive, all the movements in this part of its body were brought about by these muscles.

Explain that **our own muscles are red flesh** *just like this, and they act in precisely the same way in moving the bones.*

Point out that, solid as this piece of red beef looks, it is not actually so solid as it seems. We can see that it looks damp or moist on the outside, and if we hung it in front of a hot fire, it would soon begin to steam.

What does that tell us? It tells us that **there must be water** in the meat. The heat changes the water into vapour.

Tell that this solid-looking flesh actually **contains a large amount of water.** *If a piece of lean flesh, weighing* 100 *lbs., were dried over a fire till all the moisture in it passed away as vapour, there would be only* **23 lbs. of dry material left.** *It would* **lose 77 lbs.** *in drying.*

Remind the children of the early experiments in evaporation, and lead them to tell that, in every case, when the vapour rises, it is only the water that is driven off. **Everything but the water is left behind.** *If time permit repeat the experiments now with solutions of sugar and salt.*

What do we learn from this? The piece of beef weighing 100 lbs. **contains 77 lbs. of water,** for it is water only that can pass away in evaporation.

Now let us consider the 23 lbs. of dry solid matter that would be left behind. This consists mainly of the very substance which we found in the hen's egg, which you first called **white of egg,** but have since learned to call **albumen.** Albumen is one of the most important of the solid materials of all flesh or muscle, both in our own bodies and in the bodies of animals.

III. BONE

Produce the shank bone. Let the children take it in their hands for examination. They will at once tell that it is **hard and rigid,** *for try as they will they cannot bend it: that it is* **very tough,** *for it will bear a great amount of rough usage without breaking; that it has* **a smooth surface,** *is* **dense** *in texture, and is consequently* **heavy** *as compared with a piece of wood the same size.*

Point out that it is the combination of all these properties that makes bone suitable for its purpose in the body.

Show the other bone which has been soaking for some days in dilute muriatic acid. Take it out of the acid, dry it and hand it round to the girls for inspection. Let them compare it with the first bone. That one is perfectly rigid, but this can be **easily bent** *and* **twisted** *into any shape, for all its rigidity is gone; it is* **very flexible** *and* **very tough.** *No matter how roughly it is used,* **it will not break.**

Show too that it can be **easily cut** *with a knife, for it is no longer hard like ordinary bone.*

The acid has dissolved out of the bone all the material that made it hard and rigid. That which remains is a **gristly sort of substance.** If we boiled it in water, it would yield **a kind of glue** which we call **gelatine.**

Show some "**jelly**" *which has been made by boiling bones.*

This gristly substance is the principal material of which bone is made. It would not make muscle or flesh, nor would the albumen of the flesh make bone.

Produce now the other bone which has been burned in the fire. Without saying anything about it, hand it to the girls and let them compare it with the one which was taken out of the acid.

They notice at once that it is **much lighter** *than that one, although both are similar in size and shape. Tell them to bend it as they did the other. It snaps and breaks up in their hands, for it is* **very brittle.** *Explain what has been done with this bone.*

It has been burned in the fire, and the burning has consumed all the gristly part of the bone. This **white brittle substance** which remains is **mineral matter**—we call it **bone ash,** and like all mineral matter **it will not burn.** *Compare it with the ashes left in the fire-grate.*

Baby's bones are made almost entirely of that gristly substance at first; they become changed into hard, rigid bone by this earthy or mineral matter.

The amount of mineral matter in the bones of an adult is more than double that of the gristly substance. How are these changes brought about?

Remind the children that the blood supplies all materials for the body, and that it gets these materials from the food. **The blood** *therefore* **gets** *its* **mineral materials** *for bone making, as well as all other materials* **from the food.**

IV. BLOOD

Tell that if a quantity of blood were dried over the fire in the way already described, 76 *parts out of the* 100 *would pass away as water vapour, and only* **24 parts of solid matter** *would be left behind.*

This solid matter of the blood contains the very materials which are required for building up the flesh and bones.

Show a bone fresh from the butcher's shop, and point out that it is **red with blood.** *The blood must flow through the bone, as well as through the muscular parts of the body,* **for it has to nourish and build up both.**

We find in the blood all the materials required for its work.

Lesson V

FOOD AND BLOOD

Provide a good picture of the alimentary canal, and as large a collection of food materials of all sorts as can be got together.

I. Eating and Feeding

In our last lesson we dealt with the building and repairing work which the blood has to do in the body. But it has other work besides that.

What is its other work? It has to provide **heat** to make the body warm, and **strength** to enable it to do its work.

How does the blood do this? It carries, in its stream, **materials which burn** in the body like fuel. It is the burning of this fuel which warms the body.

Whence does the blood get these materials? It gets them, as well as all its other materials, **from the food** and drink which we take.

Lead the children in some such way as follows to tell that if we were kept without food, the blood would be unable to do its work—the body would shrink in size and weight—we ourselves should soon lose all strength and energy for work with either body or mind.

How do you feel when you have not taken food for some time? We become **faint and weary,** and unfit for either work or play. We feel **hungry** and **thirsty.**

What is your greatest desire then? To eat and drink.

What becomes of that peculiar feeling of emptiness when the meal is over? It all passes away, and we are ready to go back to our usual tasks with renewed vigour.

Remind the children that as long as we are healthy and well, this desire for food and drink **returns several times a day.** *We are said to have* **a good appetite.** *If our* *appetite falls off, it is a sign that there is something wrong, and the doctor has to be consulted.*

Remind them too that eating and drinking are, and ought to be, among the pleasantest occupations of life ; and at the same time impress upon them that we are not to eat and drink merely for the pleasure of doing so. Some people seem to forget this, and they always end by ruining their health.

If we wish to keep healthy and strong, we must make a careful study of our eating and drinking. We must know **what to eat, when to eat,** and **how to eat.**

You will easily understand this, if you remember that THE BODY FEEDS ON THE BLOOD, and THE BLOOD itself FEEDS ON THE FOOD which we eat.

In fact everything we take in the shape of food and drink must be actually **changed into blood,** if it is to do us any good at all.

Refer once more to what was said in the preceding lesson on the repairing work of the blood—the body itself can be built up and repaired only with the proper materials ; and show from this that, as the blood has to get these materials from the food, everything we eat and drink ought to contain just what is wanted.

It does not follow that everything is food, merely because people eat or drink it. If we take things which cannot be made into blood, **they will not feed or nourish the body,** and **such things are not food.**

Explain that this makes all the difference between **eating** *and* **feeding.** *People may load their stomach to any extent, but if they take things that are unsuitable, they will get no good from them. Those people* **eat,** *but* **they do not feed.**

II. How Food becomes Blood

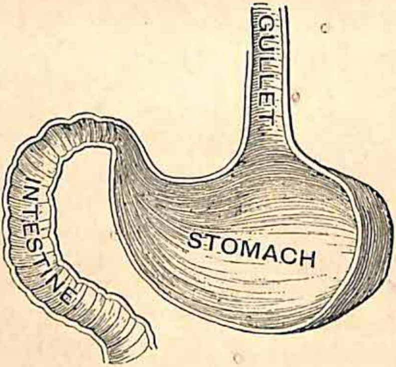
N.B.—The work of digestion must be dealt with in a very simple way here. It will be taken up more fully in the next stage.

Lead the children to think about the blood-vessels which carry the blood through the body. Tell that the smallest of them are *tubes* **finer than the finest hairs**; *yet the blood in its course through the body must flow through them.*

The solid bread, meat, pudding, potatoes, in fact all our food, must be broken up into such extremely fine particles that it may find its way into these delicate pipes, and flow along them in the stream of the blood. The food, indeed, has not merely to be broken up. **It must be dissolved,** before it can be of any use in the body. This work of dissolving the food is called **digestion.** When the food is digested, it becomes **changed into real blood,** fit to nourish the body; and nothing is of any use if it cannot be digested. Let us see how this work of digesting the food is done.

1. **In the mouth.**—*Elicit from the children themselves all they can tell of the work of* **chewing** *or* **masticating the food,** *and what it does.*

Point out that this grinding or crushing of the food by the teeth is not all—that it is moistened while it is being ground up. Tell that the fluid which moistens the food is called **saliva,** *and that it oozes out from the sides of the cheeks and*

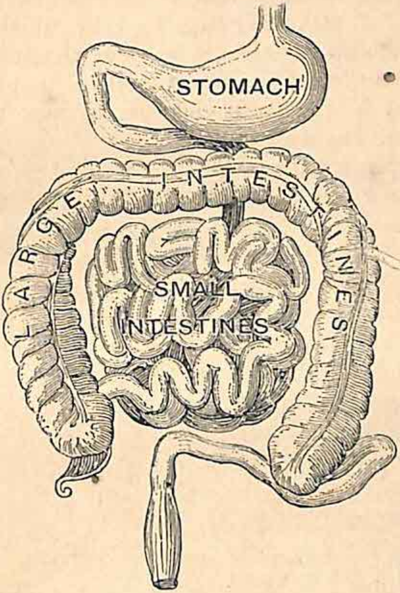


from the under part of the tongue. It is there for that very purpose. **It begins the work of dissolving the food.**

2. **In the stomach.**—*Lead them next to tell that the food when properly masticated is swallowed.*

Explain that it then passes down a long pipe—**the food-pipe**—*into the* **stomach.** *Show a picture of the stomach, and a diagram of the same in section.*

This strong bag, as soon as it receives the food, begins to roll and churn it about, from one end to the other, and so helps to still further break it up. While this is going on, **another fluid** is constantly oozing out from the inside coating of the bag. This is called the **Gastric Juice,** and its work is **to dissolve the food in the stomach.**



3. **In the intestine.**—*Show, by means of the diagram, where the stomach passes into the commencement of the* **intestines** *or* **bowels.**

Tell briefly that the food passes out of the stomach and along this long tube, and that here again other fluids are being constantly mixed with it—all for the one purpose of **dissolving or digesting it.**

As the food is dissolved or digested, it is sucked up into the blood-vessels, which spread themselves there, as well as in every other part of the body. **Digestion changes the food and drink into actual blood.**

III. SOURCES OF FOOD

This part of the lesson may be made very interesting, if the teacher will take the trouble to get together for the occasion as widely-representative a collection of food materials as possible. The various articles should be mixed up one with the other, without any regard for order, and the children themselves should be led, in some such way as this, to classify them as **animal, vegetable,** *and* **mineral** *substances.*

Commence by reminding them that all animals require food, as well as ourselves. Refer to the cat at home. What is her favourite food? A fat mouse or a bird.

Remind them that in some lands there are fierce flesh-eating animals, strong enough to carry off and devour a horse, as easily as a cat could a rat.

They feed **entirely on the flesh of other animals.** We may say that they live on **animal food.**

Turn next to consider the sheep and cows in the fields, and elicit that they would not touch food of this kind.

They feed on grass, and grass is a **plant** or a **vegetable.** Theirs is **vegetable food.**

Point out that as regards our food we are like the cat and the cow too, for **we eat animal as well as vegetable food.**

Tell that among the various articles on the table (all of which we use as food) some are supplied by the animal, and some by the vegetable world; and then select one or two girls to come to the front and classify them.

This little task, while interesting to the children, will present no difficulty which they cannot surmount. But when the classification into animal and vegetable substances has been made, the glass of water and the piece of salt will in all probability remain a puzzle to the children at first.

A hint from the teacher will quickly remove the trouble as far as the salt is concerned. It is **got out of the earth***; it is neither animal nor vegetable matter. What is it? It is a* **mineral.**

Point out, too, that water comes out of the earth; we may often see it pumped up, or drawn up in a bucket from a well. We will set it side by side with the salt as a mineral.

Our food consists of **animal, vegetable,** and **mineral substances.**

Lesson VI

THE FUEL-FOODS

The teacher will require some powdered loaf-sugar, a kettle of hot water, a saucer, a spoon, and some sulphuric acid.

I. THEIR PURPOSE IN THE BODY

COMMENCE by once more eliciting from the children that food, if it is to be of any use to us, must contain two things:—(a) *suitable material for building up the substance of the body, and repairing those parts which have been worn out with work;* (b) *something which will burn in the body, and produce heat to make us warm.*

We are going to think about this burning now.

There is a good fire burning in the grate; the heat from it makes the room warm and comfortable. But suppose we left it to itself, what would happen? It would gradually die down, and at last go out altogether, and then the room would get cold.

What do we do to keep the fire going? We put fresh coal on it from time to time.

What would happen, if we threw on, instead of the proper coal, some stuff that will not burn? The fire would die out.

What is the one general name for all substances which burn in our fire-grates? **Fuel.**

Why is our body like the fire which burns in the grate? Because **it requires to be fed** from time to time **with food, which will burn** inside the body, just as the fuel burns in the grate.

What name might we give to this food which is burnt up like fuel inside the body? We might call it **fuel-food.**

Tell me once more. What is the use of these fuel-foods? They produce heat, as they burn, and so **make the body warm.**

Then what would be another good name for them? We might call them **Body-Warmers** or **Heat-Givers.**

But these fuel-foods produce something else besides heat. Think of the steam-engine; that will tell you what I mean. They produce the **force** or **power,** which makes the body work, just as the fuel produces the steam **which makes the engine work.**

Then suppose we give them another name—**force-making foods**—because of this.

Now let us see what we have learned. **Fuel-foods, body-warmers, heat-givers,** and **force-makers,** all mean the self-same article. They all burn in our internal fires, and while burning produce **heat** to warm the body, and **force or strength** to enable it to do its work.'

Picture the navvy and the blacksmith at work, and compare them with the student. The one, although sitting still perhaps all day, is working quite as hard or harder than either of the others. He is studying and thinking deeply, **working with his brain.** *We call his* **brain work,** *or* **mental work.** *They are working with their hands. We call this* **muscular work,** *because they use their muscles, just as the other man uses his brain.*

Explain that whatever the work may be—whether head work or hand work—**the power to do it all comes from the burning up of those force-making foods.**

II. OUR INTERNAL FIRES

We have spoken so much about this burning that goes on in our bodies, that it is important for you to form a correct idea of the nature of these internal fires.

All the fires which we are accustomed to see **burn with smoke and flames,** but you must not imagine your inside to be a blazing, smoking furnace.

It is quite a simple matter to produce great heat without either smoke or flame. Let me show you an experiment to prove this.

Mix a little powdered loaf-sugar into a syrup with water; put the syrup into a saucer, and let one of the girls come to the front and hold it in her hand. Pour a few drops of **sulphuric acid** *into the syrup and call upon the class to notice what takes place.*

The mixture will gradually swell up into a **black, solid-looking mass,** *not unlike a lump of coke in appearance, and so much heat will be given out that the child will be unable to hold the saucer in her hand.*

Let the rest of the girls touch the saucer to test the heat for themselves, and then remind them that no fire had been lighted in the saucer; **there was neither blaze nor smoke.**

What do you learn from this little experiment? That we can have heat without either blaze or smoke.

Remember this then, and you will understand the kind of heat which is produced in our bodies by the burning of the fuel-foods.

This burning may be further illustrated by referring to the **hot-beds** *which the gardener makes in the garden. He piles up weeds and leaves in a heap, and allows them to lie there and rot away or decay. As they decay* **they produce considerable heat,** *which may be easily detected if the hand is thrust into the heap.*

Tell that the heat is the result of a sort of **slow burning** *which is going on in the heap of leaves, but there is* **no such thing as smoke or blaze** *with that burning.*

III. IMPORTANCE OF THESE FUEL-FOODS

Compare the living body once more with the steam-engine. Both require to be fed, **the one with fuel, the other with fuel-food,** *and for the same purpose. It is the fuel in the one case and the fuel-food in the other, that produce by their burning not only heat, but also the energy or force which sets the machinery at work.*

Point out that the steam-engine requires only the one kind of food—fuel—for all its purposes.

How is it then that our living engines want something else besides fuel-food? They are able to **repair themselves** as they wear away with their work; and **they require food which will do this.**

Show that, important as these building materials of the food are, for repairing what is worn away, the force-making or fuel-foods are quite as essential, for we require every day **more than four times as much fuel-food** *as building food.*

A man doing ordinary work requires about **21 ounces of solid food daily.** That is to say, if his day's food were dried, there should be 21 ounces of solid matter left. Of this 21 ounces rather more than **16 ounces** must be **fuel-food.** This would be just sufficient to produce the necessary heat, and to provide the working force which he requires. At the same time the other four or five ounces of building materials would be quite sufficient to repair the daily loss.

Lesson VII

THE FUEL-FOODS COMPARED

Provide for illustration two small baking-tins, some ordinary chickens' mixture (wheat, maize, rice, barley, peas, and beans), some laundry starch, tallow, suet, dripping and oil, a small tin kettle and a trivet. Place one of the baking-tins on the top of the fire before the lesson commences, so that it may get red-hot.

I. INTRODUCTION

COMMENCE as usual with a brief recapitulation of what has already been taught as to the nature of these foods, and the purpose they serve in the living body. We call them fuel-foods because they burn in the body as ordinary fuel burns in the fire-grate.

*Lead the children to compare the various substances used for fuel—***wood, coal, coke, cinders***—and they will readily tell that some of them* **burn better** *in our grates, and* **give out more heat,** *than others.*

Tell that it is just so with the fuel-foods. They all burn in the body, and produce heat and vital force; but **some of them burn better** *and* **produce more heat than others.**

II. SOME BURN BETTER THAN OTHERS

The baking-tin on the fire should be red-hot by this time. If it is, throw into it a handful of ordinary chickens' mixture (wheat, maize, rice, barley, peas, and beans). Call upon the children to observe and tell what goes on.

These things all burn. They first begin to **crackle,** and become **blackened** or **charred,** and afterwards actually take fire and **burn with a dull red glow.**

*While they are burning, lead the children to tell that the corn-grains and the peas and beans are composed largely of the same substance—***starch.** *Show some common laundry starch, and call upon the class to tell how it was prepared.* **We can obtain starch** *in like manner* **from all these grains and seeds.**

Now throw a few pieces of this laundry starch into the red-hot tin, and let the children see that it takes fire after a time and burns, like the grains of corn, with a dull red glow.

It was the starchy material of the corn-grains and the peas and beans that burned just now; **it is the same starchy part** of them that provides us with **fuel-food,** which will **burn in our bodies.**

Produce the piece of tallow, suet, or lard. Show the children what it is, and without any further explanation throw it into the red-hot tin. It instantly blazes up, and **burns fiercely** *till it is all consumed.*

Explain that any of the other pieces of fat would do the same.

Next, pour a little oil into the tin. It blazes up and **burns even more fiercely still** *than the solid fat. The blaze darts up the chimney in an instant.*

Starch, fat, and oil are all alike in one respect. What is that? They all burn.

In what respect do they differ from one another? They differ in their manner of burning. **Starch is a slow-burning substance; fat and oil burn very fiercely.**

Tell that fat and oil, like starch, are **fuel-foods.** *They burn in the body, but they burn there, as they burned in the tin,* **much more readily than starch.**

III. THE BEST BURNERS PRODUCE MOST HEAT

Place another baking dish similar to the first on two or three bricks on the table. Stand the trivet in the dish, and on it place a small tin kettle, but be careful to put only a little water in it. This done, rake out a few red-hot live cinders from the fire into a shovel, and put them into the dish, and on the cinders throw, as before, a handful of the same chicken's mixture.

The children will see that the corn-grains make the fire burn more brightly, and if one of them is allowed to stand close by, she will be able to feel the extra glow of heat which comes from them as they burn.

Explain that **the grains of corn,** *like other things,* **produce heat** *in burning, and then, tell that we are going to boil our kettle with the heat which comes from them.*

The point to be noted is that, so little heat is given out by these burning corn-grains, that the water in the kettle is a long time getting hot.

Now empty the water out of the kettle, replace it with cold *water, rake out some fresh cinders into the dish, and proceed as before. But this time, instead of the chicken's mixture, throw some fat, a piece at a time, on the red-hot cinders.*

There will be no doubt about the burning this time. The children will all see and feel the effects of it, as **the fat blazes up fiercely** *all round the kettle, and in a very short time the puffs of steam from the spout will tell that the water is boiling.*

Our first experiments showed us that **fat burns better than starch.**

What do we learn from these two last experiments? We learn that fat not only burns better, but that **it gives out more heat than starch.**

How do you know that? Because the fat in the fire boiled the water more quickly than the grains of corn.

Tell that fat is **the best of all the body-warmers.** *It burns in our bodies better, and in burning gives out more heat than any other kind of fuel-food.*

IV. BODY-WARMERS

Lead the children to think of the inhabitants of the Frozen North, and assist them to describe, as far as they are able, the region itself and the people who live there.

They clothe themselves in thick furs. Does their fur clothing make them warm? No, it **cannot make them warm**; but it **keeps them warm,** because it prevents the heat of their bodies from passing away.

But how do they make their bodies warm? The food which they eat does this.

What kind of food must we all eat to make our bodies warm? **Fuel-food** or **body-warmers.**

Now think what a bitter cold land theirs is. Which of these fuel-foods—fat or starch—would be best for them? Fat.

Why? Because **fat burns better than starch** and **produces more heat.** It would warm them better than any other fuel-food.

Picture the Esquimaux at home. They hunt and kill the seals and other wild animals, but it is not merely for their skins. They feed upon the **seal-fat** *or* **blubber.** *They want it for their internal fires. It is a* **splendid body-warmer.**

Tell, too, that these people boil down the fat and make oil of it, and **they drink this oil** *as we drink tea, coffee, and cocoa.*

They also burn this oil in lamps to warm their snow houses, just as we burn coal in our fire-grates to warm our houses. **It is their fuel as well as their fuel-food.**

Why would starch be no use to them as a fuel-food?

Lesson VIII

BODY-WARMERS—FATS AND OILS

Articles required: a glass of new milk, a hen's egg, a Brazil-nut.

I. INTRODUCTION

MAKE the Esquimaux and their daily food, the starting-point for the new lesson. Picture them hungrily devouring huge quantities of blubber-fat at every meal, and washing this down with deep draughts of oil.

The mere thought of it is enough to make our very stomachs heave; but those people prefer food of this description to any other.

Tell that one adult person will consume as much as 20 lbs. of this blubber-fat day by day. He requires it as fuel **to keep his internal fires going**; *without it he would perish with the cold. It is the cold biting air which gives him an appetite and relish for this food.*

Why would not starch do as well as fat? **Because starch is a slow-burning substance**; it does not produce as much heat in burning as fat and oil do.

After the Esquimaux has made his body warm with this fuel-food, what does he do to keep it warm? He wraps himself up close in the thickest furs he can get to prevent the heat from escaping.

Now let us leave these people and think about ourselves. When do we put on our thickest and warmest clothing? In the winter-time.

Why? Because **the body gets cold more easily then** than in the summer weather.

Then if it is more difficult to keep the body warm in winter than in summer, what ought we to do besides putting on more clothing? **We ought to eat more food.**

And what kind of food in particular do we then require most? **Fuel-food.**

Which of the fuel-foods would you consider best for this purpose, starch or fat? Fat.

In this way lead the children to see how Nature herself prepares us for the kind of food most suitable to our wants. In the cold winter weather, when we require more heat in our internal fires than at other times, we find we have an appetite and relish for fat, **the best of all the body-warmers.** *We do not turn away from it with disgust then, as we do in the warm weather.*

II. Animal Fats

1. **The fat of meat.**—We will next proceed to discuss the various kinds of fat which we use as food, commencing with those that come from the animal kingdom.

It will be an easy matter to elicit from the class that **the solid fat of** *all sorts of meat, as well as the* **dripping** *which the cook collects while she prepares them for the table, must be classed* **among these fuel-foods.**

Lead them to tell too that **suet** *is simply* **the solid fat,** *just as it is taken from the carcase of the sheep and the ox; and that* **lard** *is* **pig's fat** *fried down.*

2. **The fat of milk, butter, cheese.**—*Show the glass of milk, and let the children tell all they can about it. It comes from the cow; therefore it is an animal substance.*

The cow supplies her milk in the first place to support her young calf, till it is strong enough to eat other food. It contains everything that is necessary to keep the little thing alive and make it grow.

Explain that, for this reason, we call milk one of nature's foods.

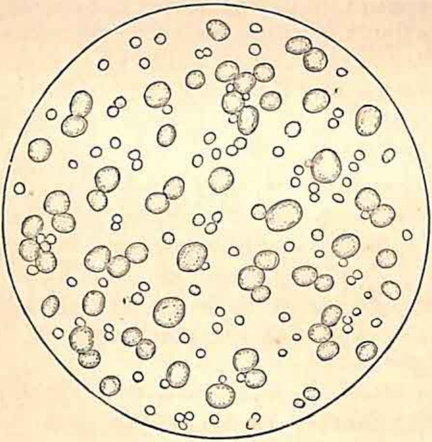
This means that **it is a perfect food**; *it contains everything that is required to support life.*

What would you expect to find in a perfect food? Materials **for building up the body,** and **fuel to burn** and make it warm.

Milk contains both these, but we will pass over the building materials in it for the present, as I want you now to think only of the fuel it contains.

Call attention to the **thick cream** *on the top of the milk, and lead the children to tell that in the dairy this cream is taken away and* **churned into butter.**

Show a drawing or a blackboard sketch of a drop of



milk, as it appears under the microscope. Explain that the **little round balls** *are nothing but* **bags of fat.**

Remind the children of their earlier lessons, and lead them to tell that at first these balls or bags of fat float about *in the milk, but that when the milk is allowed to stand, they rise to the surface and form a thick layer of cream there,* **because they are lighter** *than the rest of the milk.*

In the churning the thin skin of these little balls bursts, and **the fat forms into a solid mass,** *which we call butter.*

Lead the children next to tell what they can of the nature of cheese, the other product of milk, assisting them of course where necessary.

Point out that, although **curd is the principal constituent of cheese,** *yet in all cheeses, except those made from skimmed milk, there is more or less cream mixed with the curd.*

Hence cheese, although it is not pure fat like butter, contains a certain amount of fatty cream, and **the richer the cheese the greater the amount of cream in it.**

Cream, then, is another form of **animal fat.** It provides us with **fuel-food,** whether we take it in its simple form as it is found in milk, or after the milk has been converted into butter and cheese. **Butter is a purely fuel-food**; it contains only the **fatty part of the milk.**

3. **The fat of eggs.**—*Pass on next to consider Nature's other perfect food*—**the egg.**

Show the hen's egg, and lead the children to tell that it contains within its shell everything that is needed for the support of the little chick which would come from it, if it were hatched.

There is **material for building up the little body,** *and there is also* **fuel-food for producing warmth and vital energy.**

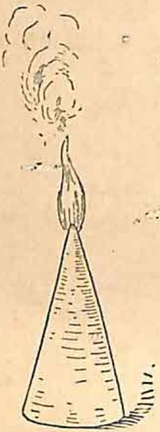
The fuel-food of the egg is stored up in the form of **an oily, fatty matter in the yolk.** The yolk of egg therefore provides us with another form of fuel-food.

4. **The fat of fish.**—*Tell that certain kinds of fish, such as herrings, sprats, pilchards, eels, mackerel, and salmon, are of an oily nature.* **These oily fish are another source of fuel-food.**

Compare them with the other class of fish, such as the sole, whiting, plaice, and turbot. The flesh of these fish is white, and **contains no oily fat**; *it cannot therefore provide us with fuel-food.*

Tell that we call the one class **fat fish,** *the other* **white fish.**

III. Vegetable Fats



Open a Brazil nut, cut the kernel into the form of a cone, stand it on its base and apply a lighted match to the apex. It easily takes light and burns with a little flame. Why does it burn?

Tell that **the nut contains oil—vegetable oil.** *It is the oil that is burning. All* **nuts** *and all* **seeds** *contain a certain amount of* **oil.**

The **corn-grains**—wheat, oats, maize—are **seeds,** and they contain a little fatty oil. **There is more or less fat in nearly all vegetable food,** and that fat supplies us with body-warming material.

Lesson IX

BODY-WARMERS—STARCH AND SUGAR

The teacher should provide herself with some flour, laundry starch, arrowroot, sugar, and sulphuric acid, a basin, a piece of muslin, some water, a shallow tin dish, a Bunsen burner or a spirit lamp, an iron spoon, and drawings of the starch granules of wheat, rice, arrowroot, and potato, as seen under the microscope.

I. Sources of Starch

Produce the specimens of the corn-grains and proceed in some such way as this:—

What is the one material which is found in all these grains? **Starch.**

How do we prepare these corn-grains for our use? We grind them into **flour.**

Here is some wheaten flour. How can we prove that it contains starch? We can get the starch out of the flour.

How shall we do it? Tie some flour up in a piece of cambric, and knead it between the thumb and finger in a basin of water.

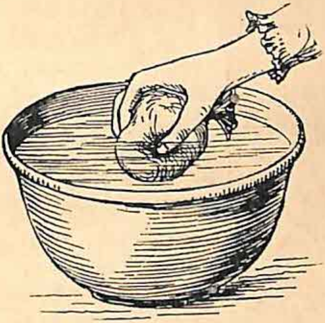
What happens then? The **starch washes out into the water.**

What becomes of the starch? It sinks to the bottom of the water.

Why? Because it is **insoluble.**

Let one of the girls come to the front and do it now.

Elicit from the class that starch could be obtained just as easily from any other kind of flour as from this, for **it exists in all the corn-grains.**



Lead them to tell that it is also found in **peas, beans,** *and* **lentils,** *and in the* **potato,** *as well as in* **sago, arrowroot,** *and* **tapioca.**

Call upon them to name the particular part of the plant in each case which yields the starch, and, in this way, deduce the fact that **it is not found in the seeds only.**

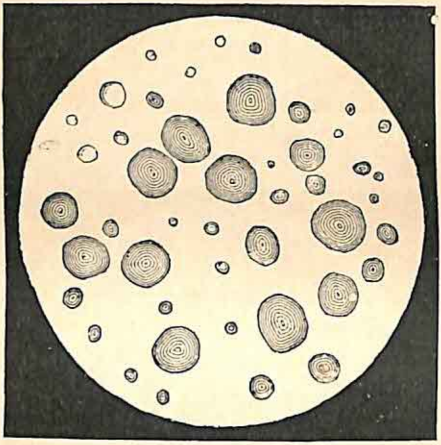
Tell that this substance is an important constituent of all plants, although some plants contain more of it than others. The growing plant prepares and stores it up as food for its own use; but one plant stores it **in the root,** *another* **in the stem,** *another* **in the seeds,** *and so on.*

II. Nature of Starch

Pour off the water now, and show **the white stuff** *at the bottom of the basin.*

Remind the children that it lies there in a wet mass, because it is insoluble in the water; that it might be dried over a gentle heat, so as to drive off the water which is mixed with it; and it would then appear as **a white, solid substance.** *Compare it with the specimens of* **laundry starch.**

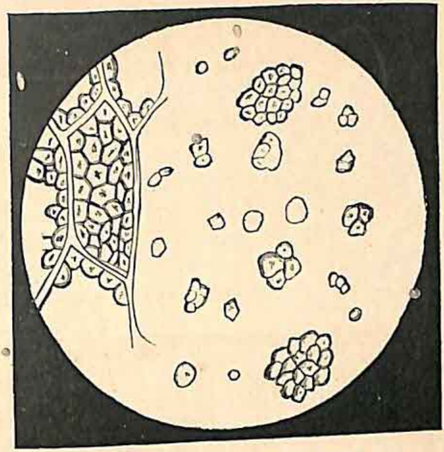
Show drawings of the **starch granules** *of* **wheat, rice, arrowroot,** *and* **potato,** *as they appear under the microscope.*



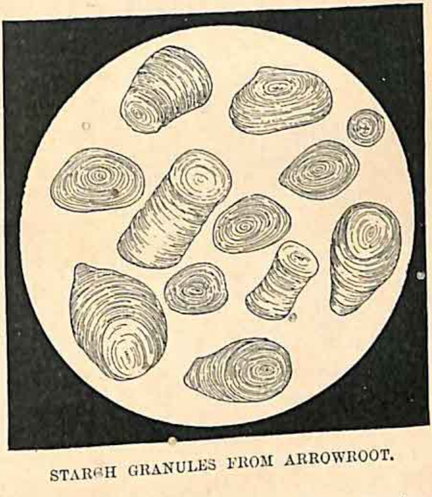
STARCH GRANULES FROM WHEAT.

Tell that starch always exists in the form of granules or cells; that these cells are much too small to be seen by the naked eye; and that we learn what they are like only by the help of the microscope.

Call attention to the **various shapes and sizes** *of the starch grains in the drawings. Explain that every plant of the same kind produces the same variety of starch grains.*



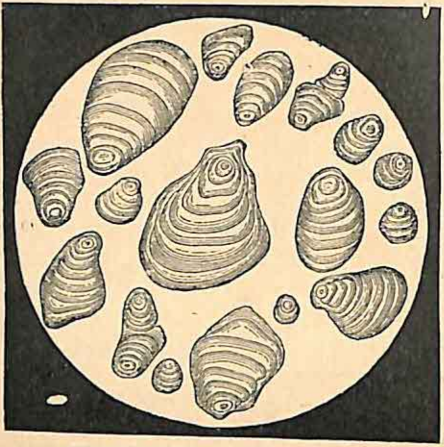
STARCH GRANULES FROM RICE.



STARCH GRANULES FROM ARROWROOT.

Rice-starch could never be mistaken, either in size or shape, for wheat or potato starch; neither could arrowroot or potato starch be mistaken for wheat, if examined under the microscope.

Tell that the knowledge of this fact enables us easily to detect if one kind of flour is adulterated with another, for **the microscope at once shows the difference in the size and shape** *of the two sorts of starch granules.*



STARCH GRANULES FROM POTATO.

III. STARCH AND SUGAR

Mix some starch in water, and add to it a little sulphuric acid. Then pour the mixture into a shallow tin dish, and boil it gently over the flame of the Bunsen burner, or the spirit lamp. When it is cool let the children taste the mixture by dipping the tip of the finger into it.

What do you observe by tasting it? The **starch tastes quite sweet**—as sweet as sugar.

Would you be surprised to know that it is not starch now? **It is sugar, not starch now.**

Explain that the acid has **changed the starch into sugar.**

Now mix a little arrowroot into a thin paste with water, and let one or two of the girls take some of it on their tongue and hold it there for a few minutes.

What do you notice? The arrowroot **begins to taste sweet.**

What is this arrowroot? It is **starch.**

What has happened, then? The starch has been **changed into sugar** in our mouths, just as the other starch was changed into sugar in the dish.

What was it that changed the starch into sugar in the dish? The acid.

Lead them to tell that the moment the starch touched their tongue, **a fluid began to ooze out** *from the tongue itself, and that it continued to flow and mix with the starch, as long as they held it there.*

Explain that this fluid is the **saliva.** *It is* **slightly acid,** *and it acts on the starch in the mouth, just as the other acid acted upon the starch in the dish.* **It changed the starch into sugar.**

But why is it necessary to change the starch into sugar? Let us see.

Where did we find the starch in the basin just now? **At the bottom of the water.**

Why? Because it is **insoluble.**

Suppose we had put sugar into the water instead of starch—where should we have found the sugar? It would have been **dissolved in the water** itself, because **sugar is soluble.**

This, then, is the reason why all the starchy matters which we eat must be changed into sugar by the saliva. **Starch is insoluble,** but **sugar is soluble,** and **none but soluble matter can find its way into the blood.**

IV. SUGAR AS FUEL-FOOD

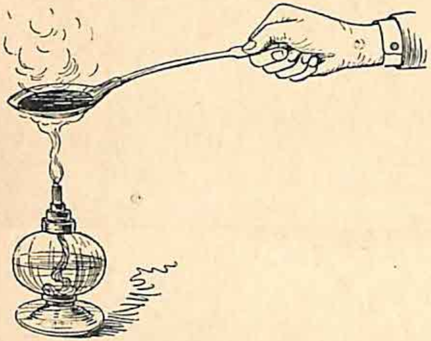
Now let us have another experiment.

Hold a spoonful of sugar over the flame of the spirit lamp. It soon becomes heated, and burns, and in burning gives out heat.

Explain that starch taken into the body as food **must be changed into sugar by the saliva.** *It is* **the sugar** *thus formed which becomes* **a fuel-food,** *for it is* **burned in the body,** *and* **produces heat and force.**

Remind the children that we prepare sugar itself from the juice of the **sugar-cane, beet-root, maple, maize,** *and other plants, and use it as food ; and that many other vegetables, and fruits of all description, contain sugar.*

Tell that even milk contains a certain amount of sugar, which is called **milk-sugar.**



Sugar of every kind becomes a fuel-food when it is taken into the body. **It is burned up to produce bodily heat and energy.**

Lesson X

FLESH-FORMERS—ANIMAL SUBSTANCES

Provide a hen's egg, a cup and a spoon, a glass of new milk, some rennet, a piece of lean beef prepared as described in the lesson, a piece of fresh-cut beef-steak, a bone soaking in dilute muriatic acid, and a basin of cold jelly obtained by boiling some bones. If possible, get beforehand, in readiness for the lesson, a small basin of fresh blood from the butcher, and a few twigs.

I. NATURE'S FOODS

1. **Eggs.**—*Show the hen's egg, and introduce the lesson as follows :—*

We are going to deal with another class of food material now, and I intend to make this egg our starting-point once more.

An egg is sometimes called one of **Nature's perfect foods.** Why? Because it contains **everything that is necessary** for the support of the little chick, till it is ready to leave the shell and seek its own living.

Do you know any other things that are like an egg in this respect? The **seeds of plants.**

Why? Because **they contain a store of food** on which the little plant lives and grows till it is able to seek its own proper food.

What are the two things necessary for the support of the little chick? Materials for **building up its body,** and **fuel-food** to make it warm.

Where is the fuel-food of the egg stored? In the **yolk.**

Break the egg in a cup, taking care not to burst the yolk, and then with a spoon remove the yolk altogether.

Point out that, as all the fuel-food of the egg is stored in the yolk, there can be none of it in the cup now that the yolk is taken away; and then proceed to examine what is left.

Elicit that it is a **clear, transparent liquid**—*that it is like water in appearance; but that if we dip a finger in it we find it is* **thick,** *and* **sticky,** *and not like water.*

Tell that we call a clear, transparent, sticky liquid like this a **glairy substance.**

Lead them next to tell its name—**albumen,** *and show the connection between this and its more common name*—**white of egg.**

Point out that **the liquid is not white**; *it is clear and transparent like water.*

Why then call it white of egg? Let one of the girls show what happens when the clear liquid is poured into boiling water. It changes to **a white, opaque, solid substance**; *hence the name*—**white of egg** *or* **albumen.**

Tell that this glairy albumen is the very substance the little chick uses to build up its body; and because of this it is called a **flesh-forming food.**

Point out at the same time that the body of the chicken is not made entirely of flesh; that it contains **bones, skin, beak, feathers,** *etc.; and that all these, as well as the actual flesh, have to be built up by the food; and in this way show that the name is a little misleading.*

Flesh-formers make flesh; but **they build up every other part of the body as well.**

Tell that this flesh-forming substance—**albumen**—*is not found in eggs only. It forms an important constituent of* **the blood and flesh of all animals.**

2. **Milk.** —*Deal in a similar way with Nature's other perfect food*—**milk.**

Call upon one of the girls to show how the **white, opaque, solid curd** *may be separated from the milk with* **rennet,** *or failing that with a little vinegar. Elicit that it is this part of the milk that is made into* **cheese.**

Explain that **the curd** *is the* **flesh-forming matter** *of the milk. It is with this substance that the young sucking calf builds up its body.*

Milk is one of the best of foods. It supplies us with **curd as a flesh-former,** and **cream as a body-warmer.**

II. THE BODIES OF ANIMALS

1. **The Lean Flesh.**—*Prepare a piece of beef beforehand as follows:—*

Wash it and squeeze it in water to get rid of the red blood, changing the water from time to time, till the washing ceases to redden it. When the blood has been all washed out in this way, the flesh itself will no longer appear red, but will be seen to consist of **a mass of whitish threads or fibres,** *with little particles of fat here and there.*

Put it, just as it is, into a bottle with some **spirits of wine,** *and in a short time the fat will all dissolve out of it, leaving nothing but a fibrous substance*—**the chief solid material of the muscles,** *or lean flesh.*

Let this be shown to the class now. Tell its common name—

fibrin, *and explain that it has another more learned name*—**myosin.**

When we eat meat, this part of it provides **the chief flesh-forming food.** The fresh meat, red with blood, contained the other flesh-forming substance—**albumen;** but in our preserved specimen that was all washed out with the blood.

2. **The Blood.**—*N.B.—Blood itself is rich in fibrin, but in washing out the blood from our specimen we wash out the fibrin as well as the albumen. It would be interesting and instructive to show the fibrin of the blood. It may be easily done in the following way.*

Obtain a small basin of freshly-drawn blood from the butcher, and with a little bundle of twigs whip the blood slowly as you would whip an egg. In a few minutes the twigs will be covered with a **red, soft, sticky substance,** *and if they are then carefully washed under the tap, till all the red colour disappears,* **a soft white fibrous matter** *will be seen clinging to them, and* **matted about them** *in a sort of network. This is* **the fibrin of the blood.**

It should be prepared beforehand in readiness for the lesson, and shown now side by side with **the fibrin of the flesh itself.**

Point out that although we have examined only one sort of meat—beef, the nature of all flesh is practically the same.

Hence, whether we eat beef, mutton, pork, veal, poultry or game, the **chief flesh-forming constituent** will always be this substance—**fibrin.**

It would be well now to show a piece of raw lean meat—freshly-cut steak for preference. Point out that the flesh, although **firm to the touch,** *is* **moist** *and* **juicy.** *This is due to the blood in it. It is* **the blood** *that provides the* **gravy** *when the meat is cooked.*

Tell that the great art in cooking meat is to prevent these juices from oozing out. When this is allowed to happen through careless cooking, the whole of the **valuable albumen and fibrin is lost,** *and the meat becomes* **tough, hard, and dry;** *but if it is properly cooked,* **the natural juices**

are shut in, *and the gravy follows the knife as the meat is cut.*

3. **The Bones.**—We have spoken about the flesh and the blood; let us now turn our attention to the **bones. Bones provide a highly valuable food material,** but few people seem to understand this, and hence it is that in many homes they are thrown aside as useless, and so wasted.

Think of the bone we soaked in spirits of salt. What was it like when we took it out? It was **tough and flexible** like **gristle.**

Show a similar bone now. Tell that this gristly material of the bone when boiled yields **a glue-like substance—gelatine**—*which is* **a very valuable flesh-forming food.** *It makes the most nutritious soups.*

Show if possible some **cold jelly** *obtained by boiling bones. It would be very instructive to the class, if the liquor and the bones as well were poured into a large basin and left to cool. When cool it could be turned out in a solid mass. Tell that this solid mass comes from the bones.* **It is gelatine** *or jelly.*

4. **Fish.**—*Remind the children of the value of fish as an article of food. Tell that the fleshy part of all kinds of fish consists of the same material*—**fibrin.** *It provides less nutriment than meat* **because it contains more water** *in proportion to its weight; but it makes excellent food* **because it is easily digested.**

Lesson XI

FLESH-FORMERS—VEGETABLE SUBSTANCES

The teacher will require specimens of wheaten flour (whole meal, brown meal, households, best whites), some bran and pollard, oatmeal and barley meal, gray, whole and split peas, broad and kidney beans, in the green pods if possible, as well as the dry specimens, lentils, haricot beans, some pea-meal, grains of wheat, tincture of iodine, and a kettle of warm water; a piece of cambric, a basin of water, a cup and a small spoon.

I. A Familiar Experiment

Tie some flour up in a piece of cambric, and commence the lesson by setting one of the girls to knead it with her hands in a basin of water, as she has seen it done before. Call upon the class meantime to tell what is going on. The water **becomes white with the starch** *which is washed out of the flour.*

Tell that our business now is not with the starch, but with the other substance left behind in the bag; and at once proceed to open and examine it.

Point out that it is a **thick, creamy-white, sticky substance**; *and call upon the class to give its name—* **gluten.** *It has been mentioned before in the earlier stages.*

Flour consists mainly of these two materials—**gluten** and **starch.**

What can you tell me about starch? It is a **fuel-food.**

Gluten, on the contrary, is a **flesh-forming substance,** like the **albumen, fibrin, gelatine,** and **curd** of the different animal foods.

It is because flour contains both these substances that bread makes such a valuable article of food. We often call it **the Staff of Life.** Why?

II. The Gluten of the Corn-Grains

Cut open a few grains of wheat, and hand them round the class for inspection. Call upon the children to describe what they observe. The whole of the middle of the grain is **a white crumbly substance,** *and all round this is* **a hard brownish-yellow material** *of a different kind.*

Explain that **the white inner part is the starch,** *the* **brownish outer layer the gluten.** *The gluten always lies* **just beneath the outer skin** *of the grain.*

Show samples of the different qualities of flour which the miller gets by sifting the newly-ground meal, such as **whole meal, brown meal, households, fine households,** *and* **best whites.**

Let the children compare the fine white flour with some of the other varieties, by rubbing them between the finger and thumb. Why is some of the meal so rough and coarse?

Show samples of **bran** *and* **pollard.** *Tell that this consists of small* **particles of the outer skin** *of the grain. It has all been sifted out from the so-called "best" flour. That is why the best flour always feels fine and smooth to the touch.*

Point out, however, that, as the little particles of skin are sifted out from the meal, they take away with them **a large part of the gluten.**

The baker's "best" flour, white and smooth as it is, is **nearly all starch**; *it is not so good for food as the brown whole-meal flour, for* **that contains all the flesh-forming gluten.**

The **whole meal of wheat** contains as much as **12 per cent of gluten.** *Explain the meaning of this*—**12 lbs. of gluten in every 100 lbs. of meal.**

The quantity of gluten gets smaller and smaller after each sifting; the "finest" wheaten flour **rarely contains as much as 10 per cent.**

Wheaten flour is used by everybody in England, and in the lowlands of Scotland; but in some of the northern parts of Scotland wheat will not grow, and oatmeal is used instead.

Oatmeal is even **richer in gluten** than wheaten flour, for it contains as much as **16 per cent of this flesh-forming substance.**

Barley flour, or **barley meal,** as it is called, contains about **the same proportion of gluten** as wheaten flour, but it is **coarse in flavour** and **colour.** It is not made into bread in these islands; it is chiefly used for feeding cattle, pigs, and poultry.

Rye-flour makes a dark, heavy kind of bread, commonly known as **black bread.** It contains **less gluten** than either **wheat, barley,** or **oats**; but it forms the principal food of the lower classes in Germany and Russia. It is never used in our country.

III. THE LEGUMEN OF PEAS AND BEANS

Produce the dried specimens of gray, whole and split peas, broad beans, haricot beans and lentils. Call upon the children to distinguish one variety from the other, and lead them, by referring them to the lessons in the earlier stage, to tell what they can about each of them.

If the season of the year permit, the green pods should also be shown.

We have one common name—**pulse**—for all these things. They are important articles of food. Let us examine them and see what we can learn about their value as a food material.

Mix some pea-meal into a thin paste with warm water, let the girls hold a little of it on their tongue, and then proceed as follows:—

What do you observe? The paste **has a sweet taste** now.

Did it taste sweet when you first put it on your tongue? No.

Why do you think it tastes sweet now? It must have been **changed into sugar.**

What can have changed it into sugar? The **saliva** from the tongue.

What substance can saliva change into sugar? **Starch.**

Then what do you learn about this pea-meal? **It contains starch.**

Let us see whether it does. If there is any starch in this paste, I can soon find it.

Show the **tincture of iodine.** *Tell that a few drops of this will immediately turn the paste* **a bright blue,** *if there is any starch in it; and then proceed to prove the presence of starch.*

Tell that not only this pea-meal but **peas and beans,** *of all kinds* **contain starch.** *We do not, however, value them so much for the starch which they contain, as for another substance.*

If all the starch could be separated out of this pea-meal, as we separated the starch from the flour, we should have a **valuable flesh-forming substance** something like gluten left behind.

Peas and beans contain **nearly a quarter of their weight of this flesh-forming material.** They are richer in flesh-forming matter than either wheaten flour, oatmeal, eggs, milk, or butcher's meat.

What is the common name for peas and beans? **Pulse.**

Explain that the Latin name for pulse is **legumen.** *The name* **legumen** *is used by learned men to describe not the pulse itself, but the* **flesh-forming matter** *which it contains.*

Tell that legumen resembles the gluten of oats rather than that of wheat, for although it contains much nutriment it **will not make light spongy bread.** *People who use it for bread prepare it in the form of flat cakes.*

In this country pulse of all kinds is mostly used for making nutritious soups.

Lesson XII

MINERAL FOODS

Place on the table for illustration a bone which has been burned in the fire, another that has been steeped in muriatic acid, a glass of drinking-water, and some rain water, a lump of lime, and some phosphorus in a bottle (merely to show, not for experiment at present).

I. INTRODUCTION

PRODUCE the bone which has been burned in the fire. The children have already examined a bone which has been treated in this way. Lead them now to tell all about it. If they compare it with the other specimen, which has not been burned, they will observe that it is **much lighter than actual bone.** *Let them compare a cinder and a piece of coal in the same way.*

The cinder was once a piece of coal just like this. Why is it so much lighter than coal now? Because some of the substance of the coal has been burned up in the fire.

Why is this burnt bone so much lighter than the other? Because, like the cinder, **it has lost some of its substance in burning.**

What would happen if we put the cinder on the fire again? It would burn away entirely, and leave nothing but **a little white ash.**

Why does the ash not burn away too? Because that is only **the mineral** or **earthy part of the coal,** and **mineral matter will not burn away.**

Perhaps our bone would burn away, like the cinder, if we put it into the fire again. Shall we try it? No, this part of the bone would never burn away.

Why not? Because **it consists only of the mineral matter**; all that would burn has been already burned up.

What part of the bone is it that has been burned up? The **gristly part** of the bone—that which yields **gelatine** when it is boiled.

Show now the other bone which has been soaking in dilute muriatic acid, and let the children compare the two.

The one taken from the acid is **tough** *and* **flexible**—*it may be bent and twisted as we please, and it is soft enough to be easily cut with a knife. Tell that this is the* **animal matter of the bone.** *But where is the mineral matter which once formed part of the bone, and made it hard, firm, and rigid? Tell that it is now in the dish. The acid* **has dissolved** *every particle of it out of the bone, and although we cannot see it,* **it is now in solution in this liquid.**

Next let them turn to the burnt bone once more. They will find that although it is much too hard to be cut with a knife, it is so brittle that it will snap in pieces rather than bend, and may **be easily crumbled up in the fingers.** *When it is crumbled up it looks like a* **sort of white ash.** *Tell that it is sometimes called* **bone ash.**

Explain that our own bones are made of exactly the same materials as the bones of the cow, sheep, and other animals; but there is a great difference between the bones of a little infant *and those of an adult.* **The infant's bones** *are* **flexible** *and* **easily bent** *and* **twisted,** *because they contain* **very little of this mineral matter,** *but they gradually get hard and firm like ours.*

How does the child obtain the necessary mineral matter to make its bones hard? Its **food supplies this** as well as all else it wants.

Before leaving this part of the subject say a few seasonable words to the girls on the need of care in nursing and handling the baby. Tell that the least roughness or carelessness is liable to bend and twist the little bones, and so make the child a cripple for life.

II. WATER AS A MINERAL FOOD

Show a glass of water. Elicit from the class that this, and all the water we use, **fell originally in rain** *from the clouds; that it either sank into the earth and formed springs, or else flowed along in streams and rivers to the sea; and that these* **springs and rivers are the source of all our water-supply.**

Remind them that when we made a classification of the various articles of food, we found we could not place water with either the animal or the vegetable substances, and so we called it **a mineral food.** *Tell that there is another reason why water must be classed with the mineral foods.*

What happens as the rain water from the clouds soaks through the soil, and the rocks below? It **dissolves and absorbs mineral matters** out of the earth, and carries them away.

Think for a moment about our lesson on **hard and soft water,** and perhaps you will be able to name one of the minerals which water dissolves out of the earth. What is it? **Lime.**

Now look at the burnt bone once more. This, you know, is all mineral matter, and **the most important mineral in it is lime.**

How do you think the lime got into the bone? It was in the water which the animal drank while it was alive.

Fill a tumbler with rain water, and lead the children to compare it with the drinking-water in the other glass. Elicit that the one looks **bright, clear, and sparkling,** *the other* **dull and cloudy.**

Let them taste the two, and they will find the rain water **flat** *and* **insipid,** *the drinking-water* **refreshing to the taste.**

How have we already learned to describe these two kinds of water? We say that rain water is **soft,** and other water **hard.**

What makes the water hard? The **lime and other minerals** that are dissolved in it.

III. Vegetables a Source of Mineral Food

Tell that this bone ash contains, in addition to the lime, another important mineral matter—**phosphorus**; *that these two minerals,* **lime and phosphorus,** *are so essential in the formation of bone, that they are sometimes called* **the bone-makers.**

Explain, too, that several other minerals besides these are met with in the body. The blood, for instance, must have **a certain amount of iron,** *or it would not be able to do its work; and other minerals are equally necessary in the formation of the* **saliva** *and* **gastric juice,** *both of which are required in the work of digestion.*

Point out that as these things are wanted in the body, they must be supplied **in the form of food.** *Then rouse the curiosity of the children by reminding them that we do not see such things as* **phosphorus and iron** *on the table at meal-time; nor do we get them, as we get lime, from our ordinary drinking-water. How then do we obtain these necessary mineral foods?*

Explain that **all the fresh vegetables** *we eat—potatoes, cabbage, peas, beans, turnips, and others*—**contain mineral matter** *of some sort.*

Point out that these things once grew as plants in the ground;

that as they grew **their roots absorbed water** *from the soil; that this water in soaking through the soil* **had previously dissolved certain mineral matters** *out of it; and that each plant took just what it required of these* **dissolved minerals** *for building up its own substance.*

Can you tell me now how we get the mineral food which we require? When we eat the vegetables **we must eat the mineral matter** which they contain.

Explain that these **fresh vegetables are valuable as food,** *chiefly on account of the* **mineral matters which they contain**; *but point out too, that all kinds of vegetable food*—**the corn** *which we use for bread, and even* **the most luscious fruits**—*contain* **mineral matter** *of some sort.*

Turn lastly to meat and other animal food. The animals which supply us with this food feed during their lifetime on grass, corn, and other vegetable matter. **These contain mineral substances,** *as we have seen, and so it happens that we cannot take even meat, eggs, milk, or any other sort of animal food without swallowing more or less mineral matter. The* **water dissolves the minerals** *out of the soil,* **the plants drink it in** *with their roots, and so* **whether we eat these plants** *or the* **animals which feed on them** *we get the mineral food we require.*

IV. SALT

There is one other important mineral food, so common that we see it on the table at every meal. Indeed it is the only one, besides water, which we ever actually see on the table. We help ourselves to as much of it as we want; we can take it or leave it as we choose; but we seem to have a natural craving for it; we do not relish our other food without it. What do I mean? **Salt.**

Elicit from the class that this mineral is obtained, like others, **through the dissolving agency of water underground.**

Tell that salt is so important that we could not live *without it. It is found* **in the blood,** *and* **in all the natural juices** *of the body;* **our very tears are salt.**

Its importance in the body is shown by the following experiment, which, however, can only be described, not performed, now.

A quantity of blood is dried till nothing but the solid matter remains. This solid matter is then burned, and about **half the incombustible mineral matter** *left behind after the burning is found to be* **salt.**

Lesson XIII

A MIXED DIET

I. Our Daily Needs

Commence by leading the children to recapitulate briefly and rapidly what has already been taught about the three kinds of food—flesh-formers, heat-givers, and minerals—and their work in the body.

Elicit, step by step, that the heat-givers or fuel-foods have another name—force-making foods; that the force or power which keeps the whole machinery of the body going comes from the heat produced by the burning of these fuel-foods; that without a sufficient daily supply of fuel-food the brain would be unfit for mental activity, the muscles would have no strength for bodily labour of any sort, and the various organs—stomach, heart, lungs, liver, and the rest—would all fail to perform their duty; that, in short, **the whole machinery of the body would suffer a loss of power,** *just as a steam-engine would if its furnace fires were badly supplied with fuel.*

Which of the three kinds of food do we require in the greatest quantity? The **fuel-food.**

How much more fuel-food than flesh-formers do we require? Between **four and five times as much.**

What does that prove? It proves that the work of providing the body with vital energy is even greater than that of making good the loss of substance through wear and tear.

Then if this fuel-food is so important, why not live on it altogether? Because without a daily supply of flesh-formers the body would lose in size and weight.

Why so? Because **the fuel-foods can only serve as fuel to be burnt up**: they contain no materials for repairing the worn-out substance of the body.

Compare both with the amount of mineral food required from day to day by pointing to the small quantity of salt which we take on our plate at dinner.

Point out too that salt is the only mineral food which we take wittingly. We want salt—we cannot do without it; but our own sense of taste tells us how much we want, and how much to eat. More than that would be injurious.

Elicit that, with the one exception of salt, we take no further trouble as regards our mineral food, provided we get a sufficient supply of **fresh vegetables** *from day to day. But explain, at the same time, that wherever people are deprived of green vegetables for long together, they fall into ill-health, and become a prey to* **scurvy** *and* **other skin diseases,** *owing to the want of proper mineral matter in the blood.*

II. NATURE'S FOOD ONCE MORE

We once called a certain article of food Nature's perfect food. What was this article? **Milk.**

Why did we give it this name? Because it contains **everything that is needed to support life.**

How do you know that? Because the little calf lives and grows entirely on the milk which the mother cow gives it, till it is big enough and strong enough to eat grass and other food.

Tell that the cow is called **a mammal,** *because* **she suckles her young calf** *in this way with milk from her own body; and point out that sheep, horses, cats, dogs, rabbits, rats, and mice—***all belong to the same order** *of animals. The natural food for the young of all animals of this kind is* *the milk of its mother. We ourselves as babies were brought up on the same sort of food.*

The following tabular arrangement will show the nature and properties of cow's milk. Let it be set out on the blackboard; and explain :—

100 ounces of milk	contain	87	ounces of	water
do.	do.	4	do.	curd
do.	do.	$3\frac{1}{2}$	do.	butter, or milk-fat
do.	do.	$4\frac{3}{4}$	do.	milk-sugar
do.	do.	$\frac{3}{4}$	do.	mineral ash
		100		

The **curd** represents the flesh-forming **fibrin of lean beef**; the **butter** takes the place of the heat-giving **fat of meat**; the **sugar** stands for the **starch of wheaten bread.** Thus **milk** has in itself the nature and properties of both **animal** and **vegetable food,** and, at the same time, it contains a sufficient supply of the necessary **mineral matter.**

This is the kind of food which Nature provides for the wants of the young of all mammals, and we cannot do better than take it as our model in arranging our own daily meals. It is sometimes called **Nature's Model Food.**

The most perfect diet is that in which animal and vegetable substances are mixed in such a way that the important food materials—**fat, starch** or **sugar,** and **fibrin, gluten,** or **some other flesh-former**—are present as nearly as possible in the same proportion as they are found in the model food—milk.

Point out lastly that the model food **contains a large amount of water.** *The nutriment in it can do its proper work in the body only through the agency of water :* **it must be washed into the blood,** *and carried along in the stream of the circulation into every corner of the body, and* **water alone can do this.**

This is Nature's way of telling us that our own food, if it is not naturally liquid like milk, **requires to be made liquid** before it can be digested in the stomach. In addition to the liquids which we take in the form of drink, **all our food contains more or less water.** A loaf of bread looks solid enough on the table, but in reality it contains **no less than forty parts of water in every hundred.**

III. ECONOMY IN FEEDING

Point out that, although experience tells us we require daily four times more heat-giving than flesh-forming food, no single article of food supplies heat-givers and flesh-formers **in exactly this proportion.**

Bread is rightly called **the staff of life.** It is the nearest approach we can get to a perfect food, for it contains a certain amount of **flesh-forming gluten,** as well as **starch, fat,** and **mineral matter.** Yet bread alone does not make a satisfying food, for it provides **more starch** and **less fat** than we require in proportion to the amount of gluten. Wheaten bread contains **six times as much starch as gluten.**

Point out that meat and pulse would be equally unsatisfactory for opposite reasons if eaten alone. They contain **too much flesh-forming matter** *in proportion to their other materials.*

Picture a man trying to live on a daily diet of lean meat. He would be obliged to eat **6 pounds of it** *every day in order to get the necessary amount of fat as a heat-giver. This enormous quantity of meat would give him* **ever so much more flesh-forming matter than he required,** *and he would soon become very ill because some parts of the body would be over-worked in trying to get rid of it.*

How could he get the heat he requires without being compelled to eat so much flesh food? By taking some **starch food,** such as **potatoes** or **bread.**

That would do it; but suppose the man tried to live entirely on potatoes. He would have to eat no less than **13 pounds of potatoes,** day by day, in order **to get the required amount of flesh-forming gluten.**

The work of trying to digest such an enormous amount of food, day after day, would rapidly **throw the body into ill health,** and the man would die.

Tell that it is for these reasons that we find it best **to use one kind of food with another,** *so as to get* **a mixed diet.** *That which is wanting in one is thus made up by the abundance of it in the other.*

It will interest the girls to learn that there is a good reason, not only for eating **bread and potatoes** *with* **meat,** *but also for such familiar mixtures as* **bread and butter, bread and cheese, bread and treacle, eggs and bacon, bacon and beans, veal and ham, liver and bacon,** *to make a meal.*

The teacher should carefully explain, in each case, the reason for the mixture. Tell that it is one of the great arts in cooking and preparing the daily food **to add to each article just what it is deficient in.**

We not only eat butter with our bread, but we mix it with flour **to make pastry,** *and for the same reason suet is always used with the flour* **to make a pudding,** *certain kinds of fish are either* **fried in fat** *or served up* **with melted butter,** *and* **melted butter** *is always eaten with* **cauliflowers.** *Explain why.*

Milk is sometimes mixed with the flour to make bread. This milk-bread is much more nourishing than ordinary bread. Why?

Rice, sago, arrowroot, *and* **tapioca** *are starches. Why do we add milk, eggs, sugar, and butter to them to make a pudding?*

GOVT. NORMAL SCHOOL, HOOGHLY

PART II.—SOURCES OF FOOD

Lesson XIV

FOOD AND CLIMATE

Have in readiness a terrestrial globe marked with chalk lines to show the five Zones.

I. Introduction

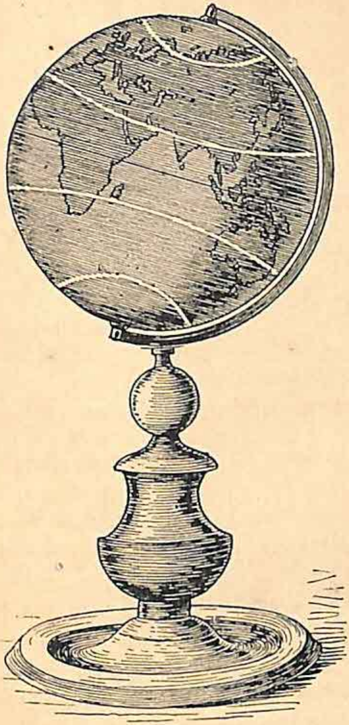
Make the previous teaching, as usual, the starting-point for the new lesson, and commence by eliciting from the class why it is that the body must have its daily supply of flesh-formers, heat-givers, and mineral matters, if it is to be kept healthy and strong. That done, proceed as follows :—

What kind of food supplies us with these materials? Nearly every article of food we eat **contains all three of them.**

Why, then, is a mixed diet so advantageous? Because no one article contains all three materials **in exactly the proportion we require.** By using one kind of food with another **we get just what we want of each material** without being forced to take more than we want of any other.

Can you think of another reason why a mixed diet must be better than any one single kind of food? It is **better for the appetite.** If we were compelled to live entirely on one kind of food we should **lose all appetite** for it, and probably **turn away from it with loathing.**

Remind the children that there is one article of food—**milk** —*which is in itself capable of sustaining life, and this is* **the best of all food for infants**; *but even milk*—**Nature's perfect food** —*would not provide sufficient sustenance for a healthy, able-bodied, hard-working adult.*



Lead the children to point out the chief reason for this. Milk is a liquid; it consists very largely of water. The man would not be able to take enough of it to provide the amount of nutriment required by his hard work.

It is important to remember too that, although milk is the most suitable food for infants in all parts of the world, **climate has a great deal to do with the selection of food** for those who are past infancy.

Our next business will be to learn that food which is suitable for one climate **is altogether unfitted for another.** People in different parts of the world have **to choose their food to suit the climate** in which they live.

II. FOOD IN VERY COLD LANDS

Produce the globe, and call upon the children to point out on it the North and South Poles, the Equator, the position of England relative to these, and so on.

Call attention to the chalk line which encloses the North Pole in a circle.

Tell that the part of the world represented within this circle is named **the Frozen Zone.** *Tell why, and explain the meaning of the name.*

Describe briefly the climate and the people who live there. Lead the children to tell that in those regions of snow and ice the people can do very little actual work, and therefore there can be **very little bodily wear and tear.**

Their great care is **to keep themselves warm.** How do they do this? They eat **immense quantities of fat,** and they wrap themselves up close in furs, to prevent the heat which it produces from escaping out of their bodies.

Picture these people at their daily meals. One man will consume as much as **seven or eight pounds of raw blubber fat** *at a sitting, and he washes his meal down with huge draughts of* **seal-oil** *or* **whale-oil.**

Remind the children of the experiment of burning the pieces of fat and starch in the fire, and in this way lead them to tell why these people use **fat and oil**—*not starch—as their* **fuel-food.**

Starch is a slow-burning substance; it would not produce heat enough to warm their bodies. **Fat and oil are the only suitable body-warmers for these people.**

Point out next that although the bodily wear and tear is small, yet they must have a certain amount of flesh-forming food. Tell that this is usually supplied in the form of **dried reindeer flesh.** *These people are almost entirely* **carnivorous**—*they make animal food their* **staff of life.**

Picture these wild inhospitable regions where little or no vegetation can grow, and then show how Nature even here *provides man with* **the very food most suitable to his wants.**

III. FOOD IN VERY HOT LANDS

Turn to the globe once more, and point out the two chalk lines, one on either side of the Equator. Show that they enclose between them all the middle of the globe **in a sort of belt.** *Tell that if similar lines could be drawn on the world itself, they would enclose between them* **all the hottest lands.** *We call this part of the world* **the Torrid Zone.** *Explain the meaning of the name, and tell in a few words the nature of the climate.*

Elicit from the class that intense heat always unfits people for hard work, and then picture the inhabitants of these hot countries. They are **wanting in energy both of body and mind;** *they spend a listless, indolent life; and consequently their* **bodily wear and tear is very small.**

These people require **very little flesh-forming food.** Many of them never eat meat or animal food of any kind. They **could not eat fat** and **drink oil.** Why not?

Rice is their **chief food.** It is to them what bread is to us—the **staff of life.**

This, together with fruits of various kinds, provides them with all their sustenance.

Point out how Nature here, as well as in the frozen regions, provides the very food which is best suited to man's wants.

In these hot lands vegetation is most luxuriant, and **rice grows** here **better than wheat** or any of the other corn-grasses. Rice contains **less gluten** than any of the corn-grains. Even the undressed rice, or **paddy,** such as these people eat, contains only **a very small proportion of gluten** just under the skin. Yet this is quite sufficient flesh-forming material for people who do so little work.

Elicit that the chief constituent of rice is **starch;** *that starch, although a fuel-food, burns slowly and produces less heat* *in the body than fat and oil. It is* **just the sort of fuel-food** *these people require to supply the necessary heat and force. Oil and fat would produce too much heat.*

IV. FOOD IN TEMPERATE LANDS

We have seen thus far that, owing to the conditions of climate, man in one part of the world becomes a **carnivorous animal,** while in another he is a **vegetarian.** But in both these extremes the race is very low down in the scale of intelligence and progress. These are not the people who have made the world's history.

Point out the **two broad belts** *on the globe between the very hot and the very cold regions. Tell that the parts of the world represented here are* **neither too hot nor too cold** *for work. The people who live in these parts of the world are* **strong and vigorous** *in mind and body, and* **can work hard.**

Elicit that as they work hard, their **wear and tear must be greater** *than that of people in either the very hot or the very cold parts of the world. These people* **require more flesh-forming food.** *They* **eat more lean meat** *than any of the others.*

Compare man with the lower animals. Point out that we have the **incisors** *or* **cutting teeth** *of the gnawing animals, the* **canines** *or* **tearing teeth** *of the flesh-eaters, and the* **molars or grinders** *of the grazing animals, and show from this that man was meant to be* **omnivorous.** *Explain the meaning of the term.*

It is only in the **temperate regions** of the world that man can indulge his natural appetite **in using a judicious mixture of animal and vegetable food ;** and English people are perhaps the largest meat-eaters in the world. Some people have tried very hard to establish a wholly vegetarian diet, but they have found very little favour with the average Englishman.

With us meat is considered a **very important article of food.** There are very few English people who do not take meat at least once a day, if they can afford it. Indeed foreign people often look with astonishment upon the healthy Englishman's appetite for meat. They regard us as a **nation of beef-eaters.**

The reason is that **we work hard,** harder perhaps than most other people, and **we require more food** in consequence.

Lesson XV

MEAT

The teacher should be provided with pictures of cattle, sheep, and pigs, and a "tin" of meat. A picture of the ice-chamber on board ship would also be interesting.

I. INTRODUCTION

COMMENCE by referring to what was said in the last lesson about the value of meat as an article of food. Meat, in some form or other, has an important place in the daily meals of all classes of the community.

Elicit from the children (1) *that the lean portion of the meat is the same kind of substance as the flesh of our own bodies—it becomes in fact a* **flesh-former**; (2) *that the fat is the* **very best of fuel-foods**; *and* (3) *that the juices of the meat always contain more or less* **mineral matter in solution.**

Point out that meat is valued chiefly because

(1) *It makes* **a more tasty and appetising meal** *than most other food.*

(2) *Being the same kind of substance as the flesh of our own bodies, it is* **more easily digested** *than other food. It is easier, that is to say,* **to make flesh out of flesh** *than out of gluten or any other vegetable matter.*

(3) *Even in sickness, when other food cannot be taken, the patient is often kept alive with* **beef-tea and broth,** *which contain all the nourishment of the meat, and give very little work to the weakened organs of digestion.*

Call upon the children to tell the names of the different kinds of meat, and the animals which provide them:—

The flesh of the ox is called beef; that of the calf is veal. The sheep supplies mutton and lamb; the pig gives pork and bacon.

Point out that each of these has its own distinctive appearance and properties, which we will now examine.

II. KINDS OF MEAT

1. **Beef** is more nutritive than any of the other meats, because it contains **more flesh-forming matter** and **less fat** than they do. Much depends, however, **on the age** of the animal, and **the way it has been fed.**

Young meat is **flabby and watery**; old meat is **coarse, tough, and juiceless.** An ox about **four years old** is in its prime.

A few hints as to the choosing of meat should be given here. Tell that good beef is always of a **bright-red colour,** *and the streaks of fat intermingled with the lean ought to give it a sort of* **marbled appearance.** *It is* **firm** *to the touch too, so that when it is pressed with the finger* **no mark is left.** *Wet, flabby-looking meat should always be avoided; it is not good.*

2. **Veal,** the flesh of the calf, is **lighter in colour** than beef. The butcher, in order to make the flesh as white as possible, **drains it of its blood.** This makes the meat **dry and juiceless,** and **difficult to digest.** It is not nearly so nutritious as beef.

3. **Mutton** is not so coarse in texture as beef. **Wether mutton** about **three years old** is best. It is then very tender and easy of digestion. The leg and shoulder are the best parts of the animal.

Mutton is a very suitable food for people who do not get much open-air exercise. Boiled mutton divested of most of its fat makes good food for the sick-room.

Point out that, as in the case of beef, the lean should be

firm *and* **elastic** *to the touch. If it is soft and flabby, or if it has a faint disagreeable odour, avoid it.*

Sometimes **the oil from the wool** *of the animal penetrates into the flesh, and gives it this unpleasant smell, which is at once detected when the meat is put down to the fire.*

4. **Lamb,** like the flesh of all young animals, is **watery** and somewhat **flabby.**

It is always dear, it is **far from economical,** and it contains **very little nutriment** as compared with other meat; and yet as it is sweet and tender it is regarded as a luxury.

5. **Pork** is **not so wholesome** or **nourishing** as either mutton or beef, and it is **not so easy to digest,** owing to the large amount of fat which it contains.

It is not a suitable food for people who are confined much in-doors, and **should never be eaten** except by those who are in good health.

To people who live an open-air life in the country it is **a very valuable food.**

They usually eat their **pork with beans,** the beans supplying **flesh-forming material** which is wanting in the fat pork.

Fresh pork about **six or eight months old** is best.

Explain that all these are commonly known as **butcher's meat.** *The animals are killed and eaten at once. The flesh of the pig is the only meat which is* **preserved** *and eaten in* **a dried state.** *It is then known as* **bacon** *and* **ham,** *and is sold, not by the butcher, but by the* **provision merchant.**

6. **Bacon** consists of the **sides** or **flitches** of the pig, cured in a mixture of **salt** and **saltpetre,** and then dried and sometimes smoked **in the smoke of burning oak saw-dust.** The hind legs of the animal, treated in a somewhat similar way, are called **hams.**

III. ENGLISH MEAT

Point out that as English people are such large meat-eaters, our farmers and graziers have for ages made the rearing of *cattle and sheep their special study, and the result is that our home-grown beef and mutton are* **the finest the world produces.**

We have two distinct breeds of oxen—the **short-horns** and the **long-horns.** Among the most highly prized of these are the **Hereford** and **Norfolk short-horns,** and the **Devonshire, Alderney,** and **Scotch cattle.** Scotch beef has no equal for tenderness and rich juicy flavour.

Among the many varieties of British sheep the **South Down** breed takes the first place. They are **smaller** than many other breeds, and are easily known by their **black muzzles** and **feet.** South Down mutton is the **richest and choicest** in the market.

The pig is a familiar animal in all parts of the country; but the **Berkshire, Wiltshire,** and **Suffolk** breeds are the most highly prized.

IV. FOREIGN MEAT

Point out that our English farmers could not possibly provide sufficient meat to feed all the people of this country, and that we have to import immense quantities from foreign lands.

1. **Live cattle.**—We bring shiploads of live cattle from the neighbouring countries of **Holland, Denmark,** and **Germany.** But we cannot bring them alive from more distant parts. Why not?

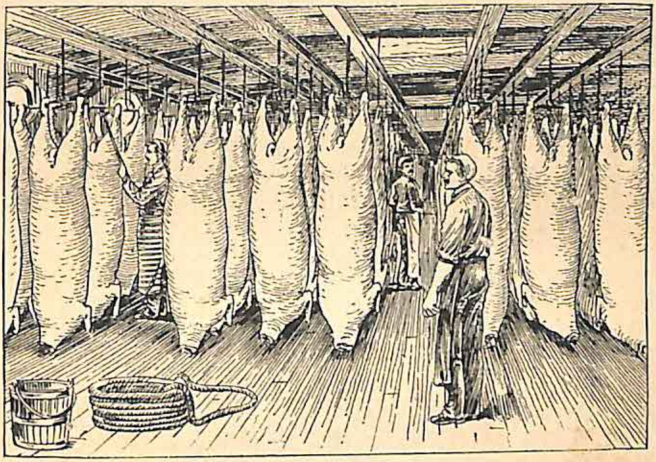
Explain that for this reason the animals are sometimes slaughtered abroad, and the dead carcases shipped to us; and then go on to show that even this plan would fail, if the meat had to be brought from a great distance. **It would go bad** *before it could reach us.*

2. **Frozen meat.**—*Tell that in* **Australia, New Zealand, South America,** *and other distant parts of the world, sheep and cattle have long been reared in hundreds of thousands, merely* **for the sake of their wool** *or* **hides.** *The flesh of the slaughtered animals is of little value there, because the population is small, but owing to the great distance it could not be brought to this country in a fit state for food,*

and hence it was simply boiled down for its **fat** *or* **tallow** *and so all this good food was wasted year after year.*

This set clever people thinking, and at last a way was found of bringing the meat here as fresh and good as when it was first killed.

Show that we owe this, like many other blessings, to steam. Compare the **fast ocean steamers** *of to-day with the* **old sailing vessels.** *Describe the* **refrigerators** (*ice-chambers*) *which are fitted up in these great ships to receive the carcases of beef and mutton. Tell that the meat* **is actually frozen** *while it is in these chambers, and* **in that state it cannot go bad.**



It is landed in this country quite fresh and good, and when we see it hanging up in the butchers' shops **it is difficult to tell it from fresh-killed meat.**

In this way good and cheap meat in abundance, instead of being wasted as it once was, is now **brought within the reach of all**—*even the poorest classes in the community.*

3. **Tinned meat.**—*Show a "tin" of meat if possible. Tell how the meat is prepared.*

It is boiled and packed in tins like this, and after all the air has been driven off, **the tins are closed up with solder,** so as to make them **air-tight.**

Explain that the meat will keep good for any length of time **sealed up from the action of the air** *in this way. Tell that this "tinned meat" is largely used on board ship. Explain why.*

4. **Bacon.**—*Tell that North America is* **the great swine-breeding region** *for almost the whole world. No fewer than* **five million hogs** *are annually killed and dressed for the market as bacon, and a large amount of this finds its way to our country.*

Lesson XVI

OTHER FLESH FOOD

I. Wild and Tame Animals

Commence by reminding the children that the various kinds of meat which we discussed in the last lesson—beef, mutton, pork, veal, lamb, bacon—are the flesh of certain animals which are kept for the purpose. The ox, sheep, and pig are **tame** *or* **domestic animals.** *The farmer breeds them and rears them with great care till they are fit to be killed for food.*

Ask for the name of the little fur-coated animals which may be seen running about in the fields in the country. Lead the children to tell that these are **not domestic animals,** *for no one keeps them;* **they live a wild life,** *and make their home by burrowing in the earth.*

Tell that the farmer shoots these **wild rabbits,** *or snares them in a trap, for the sake of their flesh, which makes excellent food,* **because it is light and easily digested.**

Elicit from the class that **hares** *are also* **wild animals,** *very similar in appearance to the rabbit, except that they are larger.*

Tell that their **flesh is very highly prized.** *It is* **rich** *in* **flavour** *and* **very nutritious,** *although it is only suitable for healthy people, as it is somewhat* **difficult to digest.**

Show a picture of a **stag** *next, and tell that this is another* **wild animal** *whose flesh is used for food. We call the flesh*

venison; *it is considered a great delicacy. It is seldom seen except on the tables of the rich.*

Wild deer are still to be met with on the **moors and mountains** of Scotland, but there are none in England now. The deer we sometimes see in the parks of the nobility and gentry can scarcely be called wild animals.

Tell that hares and deer are **hunted or chased for sport.** *They are protected by law, and no one is allowed to kill them without a license.*

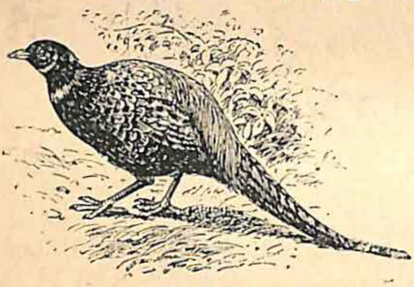
Hare-coursing with greyhounds is a favourite sport in most parts of the country.

II. BIRDS

Point out that all the animals we have dealt with thus far are mammals. They suckle their young with milk from their own bodies.

Lead the class to tell how birds differ from mammals, and elicit the names of some of the birds whose flesh provides us with food.

Ducks and geese, fowls, pigeons, and turkeys are known as **poultry.** They are **tame** or **domestic birds,** and are bred and reared for the market.



PHEASANT.

Pheasants, partridges, grouse, woodcock, snipe and a great many others are **wild birds.** They live in the woods and fields, and, like hares and deer, are protected by law, no one being allowed to kill them without a license. Those who are allowed to kill them do it for sport, and hence these birds are known as **game.**

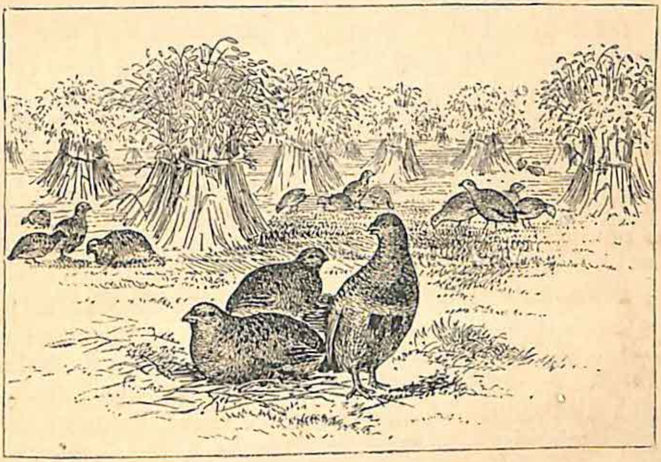
Call attention to the **enormous number of hens' eggs** *which are used as food, and so lead the children to deduce that of all the domestic birds* **fowls are the most useful.** *They not only* **give us their flesh when they are dead,** *but they provide a constant supply of valuable food* **during their lifetime.** *Compare* **the hen** *with* **the cow** *in this respect.*

The fowl, pigeon, and turkey are **white-fleshed birds.**

The flesh contains **very little fat,** and is very **light, delicate,** and **easily digestible.** Chicken provides the best and lightest of all flesh food for the sick-room.

Ducks and geese are **water-birds,** and their bodies are **very fat.** Why?

Their flesh is **dark-coloured,** not white like that of the fowl, and the fat makes it **difficult to digest**; but those who are strong enough to digest it are fond of its **rich delicious flavour.**



PARTRIDGES.

Tell that in addition to our home supply we import **millions of poultry birds** *and* **hundreds of millions of eggs** *from other countries every year.*

Pheasants, partridges, and grouse provide **very delicate, nutritious,** and **easily-digested food,** which is always regarded as a great luxury.

The **pheasant** makes its home in the **woods** and **copses**; the **partridge** in the farmer's **corn-fields** and **turnip-fields**; and the **grouse** on the **moors** of Scotland and the north of England.

Say a few words about the **game season.** *It always opens with* **grouse-shooting** *on 12th August.* **Partridge-**

shooting *begins as soon as the harvest is over; and* **pheasant-shooting** *follows this.*

III. Fish

Point out that, in addition to mammals and birds, there is another class of animals whose bodies provide us with valuable food, and so lead the children to think about fish.

Tell that fish, like poultry, may be arranged in two classes— **the white fish** *and* **the fat** *or* **oily fish***—and tell the properties of each as follows:—*

1. **White or lean fish.**—These include the sole, plaice, flounder, turbot, brill, cod, whiting, and haddock. Their flesh is **very white** and **delicate,** because **it contains no fat or oil.**

Tell that this kind of fish forms one of the best of foods **for the sick-room,** *because as it is free from fat it is* **easily digested.**

Notice, on the other hand, that in preparing any of these fish for the table the cook either **fries them in plenty of fat,** *or serves them up with* **melted butter.** *Why does she do this?*

2. **Fat fish.**—These not only **contain much oily matter** in the flesh itself, but usually have **a layer of fat just beneath the skin.** Among the fat fish are the herring, mackerel, salmon, sprat, eel, and pilchard.

Explain that the flesh of these is **never white** *like that of other fish, and it is* **not easy to digest,** *owing to the fat which it contains. Such fish is not fit for people in delicate health.*

Lead the children to tell why, on the other hand, it makes **excellent food** *for those who are in good health.*

3. **A few common fish.** (*a*) **The herring.**—*Tell that this is* **the most valuable of all the fish** *that come to our markets. Herrings are caught in such abundance round our shores that they provide a never-failing source of cheap and excellent food for the poor.*

Elicit from the class that we eat them **fresh** *as they are taken out of the sea, and we cure them in various ways for* *future use. Let them describe* **bloaters, red herrings, kippers, pickled herrings.**

(*b*) **The mackerel** ranks next after the herring, both in its abundance and in the favour in which it is held by all classes. It should be eaten **as soon as possible after it is caught,** as it quickly begins to decay, and is then highly dangerous.

(*c*) **The cod.**—*Tell that although the flesh of this fish is white and devoid of fat, a large amount of* **fatty oil is stored up in the liver. Cod-liver oil** *is prepared from this. Tell its uses as a* **medicine** *and an* **easily-digested fuel-food** *combined.*

The cod is a splendid fish, sometimes weighing as much as forty pounds.

It is abundant and cheap, and is therefore an important article of food.

(*d*) **The haddock** is eaten **fresh,** and it is also split open and smoked in much the same way **as the herring is kippered.**

(*e*) **Salmon** is most highly prized. Its **flesh is pink** and very **delicious in flavour,** but it is too costly for the tables of the poor.

Explain that immense quantities of **"tinned salmon"** *are brought to England every year from the American rivers.*

(*f*) **The flat fish.**—These, which include the **sole, plaice, turbot,** and **brill,** are favourites with everybody, owing to the delicate nature of their flesh, but **turbot** and **sole** are **the most highly prized.**

IV. SHELL-FISH

Close with a few words on the value of the so-called **shell-fish** *as food. Elicit from the children that these animals, although they live in the sea,* **are not fish.**

Tell that one class are **soft-bodied animals** *like the snail and the slug; they are properly called* **molluscs**—*a name which means* **"soft-bodied."** *They are enclosed in a* **hard solid case** *or* **shell** *for the sake of protection.*

The commonest of these molluscs are **oysters, mussels, whelks, periwinkles,** and **escallops.**

Point out the difference between these and the **crustaceans** *(the crusty family as they are sometimes called)*—**shrimps, prawns, crabs,** *and* **lobsters.**

Tell that these so-called shell-fish are all **very delicious in flavour** *but* **very indigestible.** *They should never be eaten except by those who are in robust health.*

Lesson XVII

BREAD

Articles required for illustration: specimens of white, brown, and whole-meal bread, some grains of wheat, rice, and maize, meal of various sorts, oats in the ear, specimens of corn-flour, oswego, maizena.

I. INTRODUCTION

PRODUCE the specimen loaves. Tell that bread is to be the subject of the lesson, and proceed as follows:—

People in every part of the globe, with the exception of the Frozen Zone, make bread of some kind their chief food—their **staff of life**; and although **the material** from which their bread is made **may not be always the same,** it is in every case **a vegetable substance.**

The **cereals** or **corn-grains** provide the bread-making material for quite **four-fifths** of the entire population of the globe.

Explain the derivation of the name **cereal** *from* **Ceres** *the fabled* **goddess of corn.**

Elicit from the children that all these corn-grains contain abundance of **starch for fuel-food,** *together with more or less* **flesh-forming gluten,** *as well as* **mineral matter,** *and even* **some amount of fat**; *and show that they are thus admirably adapted for their purpose.*

II. WHEATEN BREAD

Call attention to the **white** *loaf.*

What is the material of which this bread is made? **Wheaten flour.**

Here is another, but it is **brown,** not white. What is the material used for this brown bread? That is made of **wheaten flour** too.

Now look at this one. It is **browner** and **coarser-looking** than the last.

The baker calls it **whole-meal bread.** What is the material of which this is made? **Wheaten flour.**

In this way lead the children to tell the nature of the grain and the flour made from it; the position of the gluten **immediately under the skin** *of the grain; and the changes that the whole-meal undergoes* **in the sifting process.** *Show specimens of the grain, and the various sorts of meal.*

Tell that bread made from whole-meal is **more nutritious** *than that made from fine, white, sifted flour,* **because it contains all the gluten;** *but it has an irritating effect on the coats of the stomach, and some persons cannot digest it.*

Explain that ordinary brown bread is made with flour from which the coarser portions of the bran have been removed by sifting.

Impress upon the children the following important facts.

(1) New bread is **not so digestible as stale,** and should be eaten with caution.

(2) Bread **one or two days old** is best.

(3) The so-called luxuries—**muffins,** and **crumpets,** and **hot rolls**—are **most unwholesome food,** and should be avoided.

Remind them that the usefulness of wheaten flour does not end with the actual loaf of bread, for in addition to this it provides the material for **puddings, pies, pastry, cakes,** *and* **biscuits** *of various sorts.*

III. OATMEAL

Explain that in some of the bleak northern lands wheat will not grow, but **the oat is a hardy plant,** *and is able to stand the rigour of the climate.*

In these parts oatmeal takes the place of wheaten flour as the "**staff of life.**" *This is especially the case in the north and west of Scotland, where* **oat-cake** *and* **oatmeal porridge** *are largely used instead of wheaten bread.*

Show some oats in the ear, and ask the children to explain the purpose of the peculiar arrangement—each grain hanging from its slender thread with its open end downwards. Compare this with the ears of other corn.

Notice the admirable arrangement that is thus made by Nature in providing for the people of these parts **a hardy plant** *exactly* **suitable to the climate**; *and then proceed to show that it is also exactly fitted to their wants.*

Oatmeal contains **much more gluten than wheaten flour,** and **ten times as much fat**; and the fat being a fuel-food is the very thing that is wanted in that cold bracing climate. It makes **an excellent staff of life.**

Explain that such food **would not be at all suitable** *in the hot relaxing regions of the world, for the large amount of fat has in itself* **a relaxing effect on the body,** *although this is not felt in those cold northern lands.*

Curiously enough the oat is not only unsuitable for food in hot lands, but **it would not grow there.**

It would be interesting to separate the gluten from some oatmeal for the children to examine. Instead of being a close, sticky substance resembling bird-lime, like the gluten of wheaten flour, it consists of somewhat **loose crumbly grains,** *which have* **little power of holding together.**

This will explain the reason why oatmeal is always made into flat cakes. It **will not bind together** *to form* **light, spongy bread.**

Tell that in this country oatmeal is prepared in various ways, and sold under various names, for making **porridge** *and* **gruel** *for the sick-room. It is also used for making* **fancy biscuits.** *Show specimens of these wherever possible.*

Barley and rye contain about **the same proportion of gluten** as is met with in wheaten flour, but the meal from both is **coarser in flavour** and **colour,** and the bread made from them, instead of being light and spongy, is **dark, close, and heavy.** Rye bread forms the staff of life of the masses in Russia.

IV. RICE

Show some rice, and lead the children to tell the nature of this grain, so far as it has already been described. They know that it contains **abundance of starch,** *but* **less gluten** *than any of the other cereals; that it grows only in the* **tropical parts of the earth;** *and that it is to the people of those parts what wheat and oats are to the inhabitants of colder lands* **—their staff of life.**

Point out now the other peculiarity of rice. It is singularly **wanting in fat** *as compared with the other corn-grains, and fat is not only very heating, but also has a relaxing effect on the system. This lack of fat gives rice a* **binding effect** *on the bowels,* **the very thing that is wanted in those hot, relaxing climates.**

*Show from these facts that it cannot be a mere accident that this grain—***rice***—grows in lands, and under conditions, where it would be* **impossible to grow either wheat or oats.** *It grows just where it can provide* **the most suitable staff of life;** *and rice is said to feed* **fully one-third of the entire human race.**

We use rice in this country mostly in the form of **puddings** made with **milk, eggs,** and **butter.** Why is it advisable to add these things?

V. MAIZE

Show some grains of Indian corn. Tell that this, like other corn, is ground into flour, but as it contains **very much less**

gluten *than wheaten flour, it is not used to any extent in England for making bread.*

Show a packet of **corn-flour,** *and ask the children to tell the uses to which it is put in making* **milk-puddings** *and* **blanc-manges.**

Explain that this **corn-flour** *is* **prepared from maize.** *Nearly all the maize that is brought to this country comes in the form of corn-flour, or else in similar preparations such as* **oswego** *and* **maizena,** *which form important materials in the* **biscuit manufacture.**

Tell briefly the mode of preparing corn-flour.

The grains are soaked till they swell up and become soft, and then they are crushed between revolving rollers in a tank of water. As the crushing goes on, the **water becomes white and milky-looking.**

Remind the children of the experiment of washing the flour in the muslin bag, and they will readily understand what goes on.

It is **the starch of the grain** which makes the water **milky-looking.**

When the crushing is over, the liquid is made to pass through sieves, which hold back the **pieces of husk and skin,** and of course the **gluten** which adheres to them. The milky-looking liquid which passes through the sieves **contains only the starch** of the grain. This gradually settles at the bottom of the tank into which it flows, and it is then dried over a gentle heat.

Impress upon the girls that as this corn-flour contains nothing but starch, **it cannot make a nutritious food alone.** *Hence in every case in which it is prepared for the table, it must be mixed with* **plenty of good rich milk.**

VI. Other Grains

Among the other grains used in various parts of the world are **buckwheat** and **millet. Buckwheat** is grown in **America,** and among the backwood settlers it is **made into cakes,** which are said to be delicious.

Millet is the common name for a small kind of grain which is largely cultivated in **India, Egypt,** and **Central Africa**, under the name of **Dari** or **Dhoora.**

It yields a **fine white flour** containing **8 or 9 per cent of gluten.**

Lesson XVIII

PULSE

Provide for illustration specimens of pulse as mentioned in the lesson—peas, beans, lentils, lupin-seeds, and ground nuts, some pea-meal, and tincture of iodine. The green pods of peas and beans should be shown as well as the loose seeds, if the season permit.

I. INTRODUCTION

INTRODUCE the new lesson by referring once more to the important place which the cereals occupy among the articles of food as the great bread-making material. Corn of one kind or another provides the daily bread of fully four-fifths of the human race.

Point out that these corn-grains are used in the form of **fine meal** *or* **flour.**

Tell that the Latin name for flour is **farina,** *and so show the reason for the name* **farinaceous food,** *which is sometimes given to this class of material.*

Show the specimen of **pea-meal.** *Tell that this too is* **a kind of flour,** *although it is made, not from corn of any kind, but from* **peas.**

Elicit from the children that peas, beans, and lentils belong to a class of vegetable products, which are known by one common name—**pulse.**

Write the word on the black-board, and tell that in certain parts of the world pulse of one kind or another is **the actual staff of life**—*the everyday bread of the people,*—**just as corn is with us.**

Show specimens of peas and beans, loose as well as in the pod.

Elicit that they are **the seeds** *of the plants, and tell that they and all other varieties of the pulse family* **grow in pods** *of this kind.*

Peas, beans, and lentils form a useful kind of food-material with us, although they do not actually provide our staff of life. We use them in the dried or ripened state for preparing soups, stews, and other dishes; and in addition to this, **peas and beans** supply us with **fresh green vegetables** during the growing season.

II. PROPERTIES OF PULSE

Elicit from the class that the usefulness of pulse as an article of food is due to the fact that these seeds, like the corn-grains, contain **both flesh-forming** *and* **fuel food.** *They contain* **more flesh-forming material** *than any kind of grain, and this makes them highly nutritious.*

Tell that 100 *lbs. weight of pulse yields about* **24 lbs. of this flesh-forming gluten,** *and proceed to elicit the properties of the material.*

What is the special name for the gluten of pulse? **Legumen.**

Why is it so called? Because **legumen** is the Latin name for **pulse,** and it is used to distinguish the flesh-forming material of pulse from that of corn and other plants.

Is the legumen of pulse like the gluten of corn in appearance? It is **more like the gluten of oats** than that of wheat.

In what respect? Because it is in **loose, crumbly grains,** while the gluten of wheat is **a close, sticky substance** something like bird-lime.

Tell that the legumen, when separated from the meal, is found to be very similar in character to the **curd** *(casein)* **of cheese;** *and that the Chinese actually* **make a kind of cheese** *from the legumen of peas.*

Lead the children to tell that, owing to the peculiar nature of legumen, wherever pulse-meal is used for bread, it is always *prepared in the form of* **flat cakes.** *Like oatmeal* **it will not make light spongy loaves.**

*Proceed next to elicit the name of the other important material in the pulse-meal—***starch.** *Call upon the children to show how they would prove the presence of starch in the meal, first by mixing a little of it into a thin paste and holding it on their tongue, and also* **by the iodine test,** *as shown in a former lesson.*

Point out that the various kinds of meal or flour from the corn-grains also consist of starch in addition to their glutinous flesh-forming material.

The great difference between pulse-meal and these is that it is **richer in flesh-formers** *than the best of them—oatmeal.*

Pulse-meal differs from oatmeal in another respect. It contains a **very small proportion of fat**—not more than **2 parts in 100.**

Oatmeal is rich in fat; it contains as much as 10 per cent of fat.

The **abundance of fat** in oatmeal makes it **a relaxing food,** especially in warm weather: and pulse if eaten alone would be an equally unsuitable food, for the **small proportion of fat** in it produces **a constipating effect.**

Explain that a mixture of beans and oats is found to be the best food for horses which are engaged in hard laborious work. Both foods contain a large proportion of gluten, and the **abundance of fat in the oats** *makes up for the* **deficiency of that material in the beans.** *This mixture of food gives the animals more strength and endurance than any other.*

III. VARIETIES OF PULSE

Show some French or kidney beans. Remind the children that in the summer time we use these (pods as well as seeds) in the form of a **green vegetable.** *If the season permit, show the green pods.*

These beans are natives of India, but they are now grown in most temperate climates. The useful haricot bean is simply the **ripened seed of a kind of French bean.**

Show specimens of these, and explain their uses.

Show next the specimens of broad or Windsor beans. Provide them, if possible, both in the green pod, and also in the ripened state.

We grow this kind of pulse for use as a green vegetable; but we do not eat the pod itself. **We use only the seeds,** and we do not eat the seeds in their ripened state. The ripe beans are employed for feeding horses, and are commonly known as **horse-beans.**

Show the specimens of peas (whole, split, and gray), and if the season permit, the green peas in the pod. Point out that these, like beans, supply us with **green vegetable food** *during the summer, but they also provide in their dried state a* **nutritious material** *for* **soups, stews,** *and other dishes.*

Lentils are used **only in the dried state.** *Hand the specimens round the class.* These seeds yield a **highly nutritious flour or meal,** from which is prepared the well-known food—**revalenta**—so much used for infants and invalids.

In Lombardy (North Italy) **lupins** are grown very extensively.

Show, if possible, specimens of the dried pods. They belong to the pulse family.

The small seeds are **ground into a meal with chestnuts,** and made into bread which forms the staple food of the common people.

Show some **ground nuts** *or* **pea-nuts,** *as they are sometimes called. The children will probably know them better under the name of* **monkey-nuts.**

These are, properly speaking, **a kind of pulse,** and in the tropical regions where they are grown, they are used as **the daily food for both man and beast.**

Explain that these so-called nuts contain about **half their weight of oil.** *We import them into this country for the sake of their oil, but when the oil is pressed out of them, they form a valuable food for cattle*—**oil-cake.**

There is a small kind of pulse grown in the East, and known as **chick-pea** or **gram.** Travellers about to cross the desert carry with them a supply of these peas, roasted ready for use. Heavy, bulky food would be an encumbrance; these peas are light, and take up little room, while at the same time they are said to be **more life-sustaining** in their properties **than any other food.**

Lesson XIX

SOME STRANGE BREAD STUFFS

The teacher will require specimens of sago, arrowroot, and tapioca, and a banana and a date should also be shown, if they can be obtained. Pictures of the sago and date palms, the bread-fruit tree and the banana should be at hand.

I. INTRODUCTION

WE have seen that although the vast majority of the human race all over the world depend upon corn of some kind for their daily bread, yet the different varieties of pulse also play an important part in the feeding of man and animals.

We shall next proceed to consider some very curious kinds of bread material, which form the staff of life in lands where neither corn nor pulse are used.

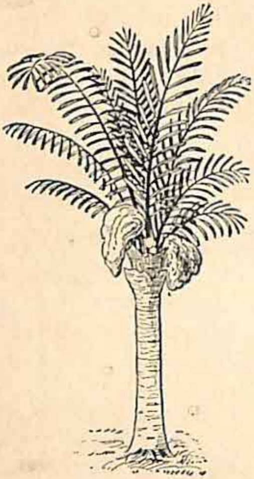
II. MORE STARCH FOODS

1. **Sago.**—*Show the specimen of sago; tell what it is, and let the children examine it for themselves. They will probably recognise it as a material for making puddings.*

Tell that it is **almost pure starch,** *and that it is obtained from the* **soft central pith** *of the stem of a tree. Show a picture of the tree, and point out that it is not at all like the trees we see here.*

Lead the class to notice its chief characteristics. It has a straight, smooth stem, entirely without branches, but there is a cluster of very large feathery leaves at the top.

Trees of this kind are called **palms**; they all grow in hot tropical lands. This one is called the **Sago Palm.** It grows chiefly in New Guinea and Africa.



When it is fully grown it is a **fine tree about 30 feet high.** It only blossoms or flowers once, and when that happens it is a sign that the tree has reached maturity.

Immediately the flowers begin to show, the tree is cut down, and the **soft, gummy-looking pith** is removed from the middle of its stem.

The pith is broken up into small pieces and then put into a tank of water, where it is **kneaded and crushed and strained,** until **all the starchy meal** is pressed out of it.

This settles at the bottom of the tank, and is collected by draining off the water. It is then partially dried in the sun, and in this state it is pressed through sieves, to give it the **round, granular appearance** as seen in the specimen.

Tell that sago forms the chief food of the natives of the lands where this tree grows. It is their **staff of life.** *They bake the meal into a* **kind of bread** *or* **hard cake.**

We ourselves use sago, mixed with **milk, eggs,** *and* **sugar,** *for puddings.*

Why is it advisable to add these things to the sago?

2. **Arrowroot.**—*Show some arrowroot, and tell that this too is* **nearly pure starch.** *Let the children rub some of it in their fingers, and they will notice the* **peculiar starchy feel** *it has.*

Tell that it is mostly used, mixed with milk, for the sick-room, as it is a **light, easily digested food** *for invalids and children.*

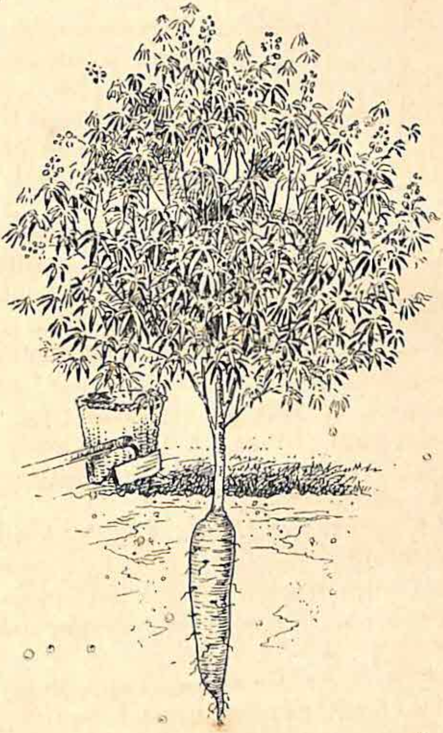
Explain that although called arrowroot it is **not made**

from the root *of the plant, but from the* **underground stem.** *Tell briefly how it is prepared.*

When the plant is ripe it is taken up, and the underground parts of the stem, after being washed and peeled, are broken up into **a kind of pulp** in cold water. When it is left to settle, the pulpy mass **sinks to the bottom,** and the water is drained off.

Nothing remains but to dry the sediment, and then it appears as a beautiful, **white, glistening meal** or powder, such as we have here.

3. **Tapioca.**—*Produce the specimen. Tell that this too consists almost entirely of* **starch,** *and is prepared from the*



root of a plant, *called the* **cassava** *or* **manioc,** *which grows in the tropical parts of Africa and America.*

The root is something **like a turnip** in appearance. When it is fit for use it is pulled up, cut into pieces, **mashed into pulp,** and kneaded and strained in much the same way as the arrowroot is treated.

Tell that, strange as it may seem, the pulpy substance of this root **contains a deadly poison,** *in the form of a* **milky-looking juice.** *Point out that, before such a substance can be fit for food, it is necessary to get rid of this poison. Explain how it is done.*

When the pulpy mass has settled at the bottom, the water is all drained off. Fresh water is then added in its place, and the pulp is again stirred for some time to mix it well with the water.

The **starchy matter,** being insoluble, **sinks to the bottom** as soon as it is left to stand, but the **milky-looking poison dissolves,** and so, when the water is drained off again, it carries the poison juice away with it.

These washings are repeated several times, till every trace of the poison is removed; after which the starchy sediment is collected and dried on hot plates.

During the drying process it is stirred continually with an iron rod.

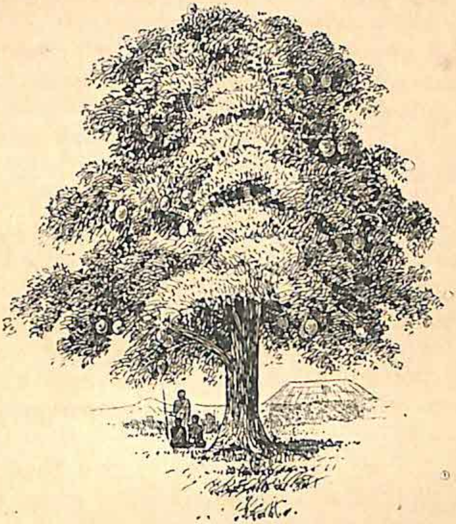
It is this which gives the tapioca its peculiar lumpy appearance.

III. The Bread-Fruit

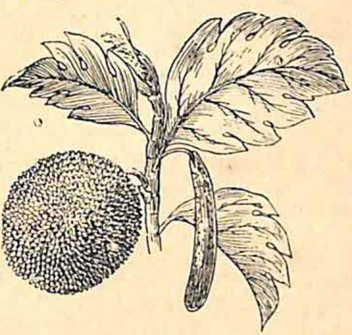
Show, if possible, a picture of this wonderful tree. Explain that to the natives of the South Sea Islands the fruit of this tree is the staple article of food. It is to them what our wheaten loaf is to us. It is **their bread.**

The fruit grows very abundantly, each tree bearing and ripening crop after crop in succession for about eight or nine months of the year. So abundant are the crops that three trees are sufficient to support a full-grown man for eight months of the year.

The fruit consists of a **porous mealy pith** enclosed in a tough outer rind.

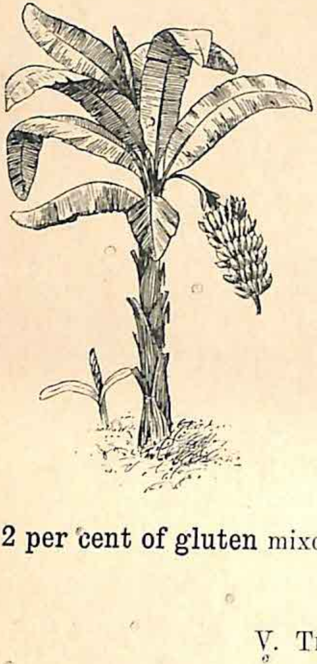


It is usually plucked before it is quite ripe, and **baked**



on hot stoves. It is said to taste, when cooked, **very much like wheaten bread.**

IV. THE BANANA OR PLANTAIN



Show a picture of this tree. Tell that it is a native of Central America and other tropical countries, and that the people of those parts depend upon the fruit of this tree for their chief support. It is **their bread**—*their* **staff of life.**

A sample of the fruit itself might be easily obtained. Procure one, if possible, and have it examined.

Within the thick, outer rind is a more or less **mealy substance,** which when dried in the oven **resembles bread** both in taste and composition.

It is less nutritious than some of the other bread-stuffs, as it contains a large amount of water, and only about **2 per cent of gluten** mixed with the starch.

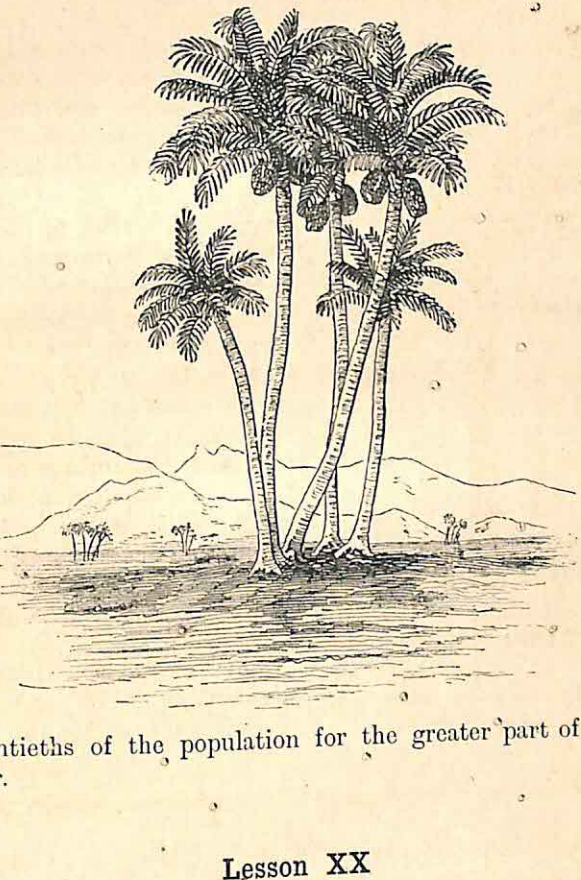
V. THE DATE

Show a picture of the date palm, and some specimens of the fruit.

Tell that this tree grows in the northern parts of Africa; the fruit is commonly known as **the bread of the desert.** *Describe the region briefly.*

Wherever a spring of water exists in those burning sandy deserts, the date palm is sure to be found. When every other crop fails, this tree will flourish in spite of the drought.

The people of the oases dry and pound the fruit into **a kind of cake**, and it becomes **the bread** of nineteen-twentieths of the population for the greater part of the year.



Lesson XX

GREEN VEGETABLES

Articles required for illustration: a common fire-shovel, a cabbage, pictures of the growing potato, carrot, turnip, and onion, and bulbs of the lily, tulip, hyacinth, and crocus.

I. INTRODUCTION

COMMENCE by reminding the class that in addition to the plants which furnish man in all parts of the world with some form of bread material, there are others of a different character, on which we depend to a large extent for our daily food supply. Among the most important of these are the **fresh** *or* **green vegetables.**

Call upon them to enumerate the different vegetables to be seen in the green-grocer's shop; and lead them to tell that it is the **root of one** *plant, the* **stem of another,** *the* **leaves of another,** *and the* **seed pods of another,** *that provide the food supply. The earlier lessons will enable them to do this readily enough.*

They should also be led to tell from their own observation how the various vegetables are used.

Most of them **require to be cooked** before they are fit to eat.

Some, such as the onion and celery, are eaten in the **raw state** as well as **cooked.**

Others, including the lettuce, endive, water-cress, radish, mustard and cress, and cucumber, **are always eaten raw,** in the form of a salad.

Besides these there are certain herbs, such as parsley, mint, and thyme, which are used mainly **for flavouring purposes** for soups, stews, and other made-up dishes.

II. THEIR VALUE AS FOOD

1. **They provide mineral matter.**—*Place a common iron shovel over the fire, and when it is red-hot throw a fresh cabbage leaf on it, and let the children watch it burn away. When it has ceased to burn, stand the shovel aside to cool, and point out that there is something left behind,—that the whole of the leaf is not consumed.*

Why is this? The part left behind is nothing but **ash** or **mineral matter. It will not burn.**

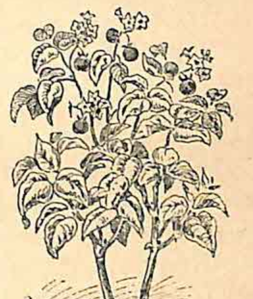
How did this mineral matter get into the leaf? The roots of the growing plant **absorbed it from the soil.**

Should we find mineral matter in any other kind of vegetable? Yes, **all plants take up minerals** of some sort from the soil, just as the cabbage does.

Lead the children to tell that this mineral food is of the highest importance to the growth and well-being of the body. It is required for the work of **bone-making,** *and it is also necessary in the formation of the* **digestive juices.**

People, who are kept for any length of time without fresh vegetables are sure to suffer from **scurvy** *and* **other eruptions of the skin,** *owing to the want of the necessary mineral matters in the blood.*

2. **They contain gluten and starch.**—*Point out that, although these fresh vegetables are chiefly valuable for the mineral food which they supply, they all contain the other three important materials—* **starch, gluten,** *and* **fat,** *so that they are able to provide both flesh-forming and fuel food as well as minerals.*



III. The Vegetables compared

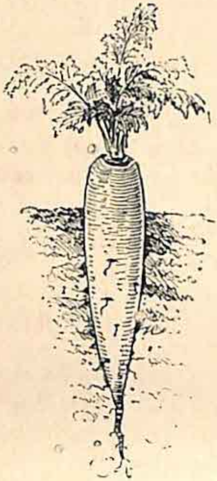
1. **Roots and Tubers.**—*Call upon the class to mention again some of the plants whose roots are used for food, and as they are given write the names on the black-board.*

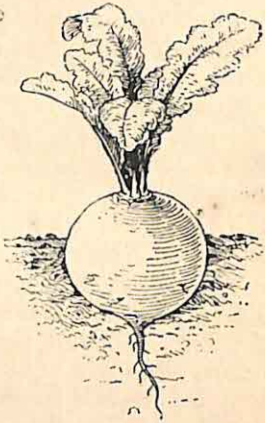
The potato will probably be given through thoughtlessness. Let the class correct this, and explain why it is wrong to call the potato a root. It is a **tuber,** *that is, a* **swollen part of the underground stem.**

Have this clearly pointed out in the picture.

The carrot, turnip, and parsnip are **true roots**—the fleshy tap-roots of the respective plants.

It will be easy to show that these underground parts of the plant (roots and tubers alike) must of necessity contain a large amount of water, **because they are constantly absorbing water from the soil.**





Every 100 lbs. weight—

(1) Of **turnips** contains **92 lbs. of water,** and only 8 lbs. of dry solid matter.

(2) Of **carrots** contains **88 lbs. of water,** and only 12 lbs. of dry solid matter.

(3) Of **potatoes** contains **75 lbs. of water,** and only 25 lbs. of dry solid matter.

If these roots and tubers be carefully dried until all the water is driven out of them, the dry solid matter in each case will be found to consist mainly of **starch** and **gluten.**

The dry solid substance of the parsnip, for instance, yields a **meal** which consists of **gluten, starch,** and

sugar combined. Hence it forms a **very nutritious food.**

The dry solid matter of the **turnip** is found, on examination, to contain **starch** and **gluten** in about the same proportion as they are found in **Indian corn.** It is not so nutritious as Indian corn, however, as it is **deficient in fatty matter.** Therefore to make turnips a really nutritious food, they should be eaten with some **fatty or oily substance.**

This explains why the farmer makes **turnips** *combined with* **oil-cake** *the principal food of his cattle during the winter months, when they are for the most part housed, and unable to seek their own food in the meadows.*

The mangold-wurzel—one of the turnip family—is a valuable root to the farmer for cattle-feeding.

The potato is by far the most important of the tubers used as food. Indeed, next to the cereals, the **potato is the most valuable** of all vegetable foods.

It feeds domestic animals as well as man, and is more extensively and universally grown than any other cultivated plant. It is largely cultivated in all mild climates, and to some extent in both hot and cold regions as well.

Tell that the 25 per cent of dry solid matter which it contains **consists largely of starch,** *with less gluten than is found in either rice, banana, or bread-fruit; yet in conjunction with other food such as* **meat, fish,** *or* **milk,** *it forms a valuable article of diet.*

To the **Irish peasant** *it is as much the* **staple food** *as* **rice** *is to the* **Hindoo** *and* **Chinaman,** *or the* **banana** *to the* **negro** *of the tropics.*

Tell that new potatoes, although regarded as a luxury, **are not so easily digested** *as the ripened tubers. They are close and waxy when boiled.*

2. **The Onion** is the **swollen bulbous stem** of the plant. **Leeks** and **shallots** belong to the same class of products. They are all remarkable for their **strong, pungent smell** and **flavour,** which is objected to by many people.

Remind the children that several of the well-known flowering plants of the garden—such as the lily, tulip, hyacinth, crocus, gladiolus, snowdrop, and others—produce **bulbs** *of a somewhat similar appearance.*

The onion is **a most valuable and nutritious** article of food. The dried solid substance of the bulb is found to contain from **25 to 30 per cent** of flesh-forming **gluten.** In its sustaining power it is said to equal the **gram** of the Eastern desert lands.

Onions are largely cultivated in this country, and they are also imported from Spain and Portugal, to the extent of 700 or 800 tons every year.

Tell that the Spanish peasant works contentedly from day to day on a **diet of bread and onions**—*the onions contributing very largely to the amount of nourishment provided by his simple meal. The large Spanish onion is much milder in flavour than our own.*

3. **Leaves.**—*Point out that the leaves of plants provide a considerable proportion of our daily food, directly and indirectly. Our sheep and oxen, and other animals whose flesh supplies us with food, live for the most part on grass. There must be abundance of nutriment* **even in the blades of grass,** *for these animals build up their bodies on it.*

Tell that, speaking generally, **leaves are rich in gluten.** *Even the dried tea-leaves contain as much as 25 per cent of this material; and if they could be eaten with relish, and were easy of digestion,* **they would produce as much flesh** *as peas and beans.*

The cabbage family—including the cauliflower, broccoli, etc.—provide us with most of the leaves which are raised for human food. These plants are extensively grown in most temperate climates.

They contain a large proportion of water—as much as 90 per cent; but their dry solid matter is **rich in flesh-forming gluten,** and this makes them a highly nutritious article of diet.

Show the nutritive value of the cabbage by describing a dish, well known and in common use among the Irish peasantry, *under the name of* **Kol-cannon.** *It is made of* **potatoes and cabbage beaten up together.**

Point out that the potato supplies **abundance of starch,** *but* **little gluten,** *while the cabbage is* **rich in gluten**; *the two combined approach the composition of* **wheaten bread.**

Add to this mixture **a little fat pork,** *and the whole gives all the constituents of* **Scotch oatmeal.**

This mixture of potatoes and cabbage beaten up together is also a common food among the peasantry in the South of France.

Lesson XXI

FRUITS

Provide for illustration specimens of as many of the common fruits as can be obtained, one or two green unripe fruits, some raisins, muscatels, currants, figs, and prunes, and if possible a pine-apple and a pine-cone.

I. The Value of Fruit as Food

Introduce the lesson by calling upon the children to name as many of the commonest kinds of fruits as they can think of, and point out that all of them are valued chiefly because of their **delicious flavour.**

Tell that they cannot be regarded strictly as foods, for although they contain **a considerable quantity of sugar,** *they are all singularly* **poor in flesh-forming matter.**

Fruit provides **very little real nutriment.**

Unripe fruit **contains starch,** not sugar, and its juice is of a peculiarly **sour, bitter, and astringent taste.** As the ripening process goes on, the **starch is converted into sugar,** and the rough sourness of the juice becomes softened into a **pleasant acid,** which gives the fruit its **peculiar flavour.**

Let the children test this for themselves with some specimens of ripe and unripe fruit, if possible.

Fruit of every kind also contains **certain mineral salts** which, together with the acid, are of great value in keeping the blood in a pure healthy state.

Elicit that we eat fruit **in its raw state** *as well as* **cooked**; *and point out that none but ripe fruit should ever be eaten raw.*

Explain too that **over-ripe fruit** *is as unfit to eat* **as fruit which is not ripe,** *and that most fruit is* **more wholesome cooked** *than raw. Notice on the other hand that certain fruits, such as strawberries, grapes, and pine-apples, do not improve by cooking, but seem to lose much of their rich flavour.*

Tell that we should all benefit very largely in health by a more free use of fruit in our daily food than is usually made; and show that the grand provision of Nature, in ripening one kind of fruit after another in succession during the year, **seems to point this out to us.**

II. English Fruits

Among our most familiar English fruits are the apple, pear, plum, damson, apricot, peach, cherry, gooseberry, currant, strawberry, raspberry, and blackberry.

The **apple, pear, quince,** and **medlar** belong to the same family of fruits, but the apple is the most useful and wholesome of them all.

It stands first among our English fruits. We eat it in its raw state, and we cook it in various ways; and so great a favourite is it that, in addition to our home-grown supply, we import immense quantities from abroad.

The **Normandy pippins,** which come to us from the north-west of France, are apples **dried and pressed flat.**

Show a specimen if possible.

Apples and pears are more easily digested, even in the raw state, than most other fruits, and the acid in them **has a healthy influence on the bowels.**

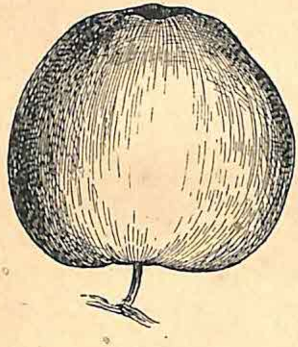
Remind the children that they are not supposed to eat the *tough outer skin, and the even tougher inside core of either apples or pears. These parts would be quite* **indigestible.**

Tell that although we now grow no less than 2000 *varieties of apples in this country, the fruit was practically* **unknown here 400 years ago.** *Most of the best apples we see to-day were introduced into England from the East* **in the reign of Henry VIII.,** *whose gardener planted* **the first apple orchards** *of Kent and Surrey.*

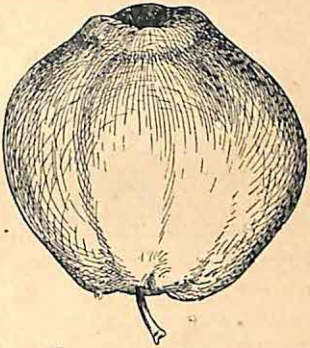
Previous to this the only apple to be found in this country was the sour, bitter **crab,** *such as may now be seen growing wild in the hedges.*

Large quantities of apples are used every year in the preparation of **cider. Perry,** another beverage similar to cider, is made from the **juice of the pear.**

The **quince,** although it belongs to the same order, is not grown to any extent here, as it ripens with difficulty in our climate. The fruit is sold preserved in sugar, or made into marmalade.



APPLE.



QUINCE.

The **medlar** is a small pulpy fruit with a tough outer rind. It is only met with occasionally.

Plums, damsons, apricots, peaches, and cherries are **stone fruits.**

The luscious cherry, although so common now, was also a foreigner once.

It was not cultivated to any extent here **till the time of Henry VIII.**, although trees were planted in various parts of the country during the early Roman occupation of Britain.

There are many varieties of the rich juicy plum. One of them, the **damson**, is so called because it was originally brought from Damascus. Its proper name is **Damascene plum.**

Point out that stone fruit of all kinds should be eaten with caution, and never unless they are quite ripe. **Unripe plums are highly dangerous.** *The best test of their fitness to eat is that* **the stone should always come away clean** *when the fruit is split open. They may then be eaten with safety.*

N.B.—*The teacher would do well to warn the children against buying unsound fruit of any kind from unprincipled hawkers in the streets, merely because they get plenty for their money. Much harm is done among children in this way during the summer months.*

Strawberries, raspberries, gooseberries, and currants are too well known to need any description here. They are all wholesome and beneficial, provided they are ripe and sound.

III. FOREIGN FRUITS

Lead and assist the children to name the various foreign fruits to be seen in our shops, such as the orange, lemon, pineapple, banana, grapes, figs, dates, raisins, and currants.

Impress upon them the great advantages which steam navigation has conferred upon us, in bringing us into such close and rapid touch with distant parts of the world, that our markets are now glutted with these delicious foreign fruits in the season.

The most important of all the foreign fruits that come to this country is the **orange.** This delicious fruit is so abundant and cheap everywhere that it is easily within the reach of all. We might be tempted to forget that it is a foreign fruit.

The fruit is brought here from **Spain, Sicily, Malta,** and the **West Indies.** It is packed green as it is gathered from the trees, and ripens during the voyage.

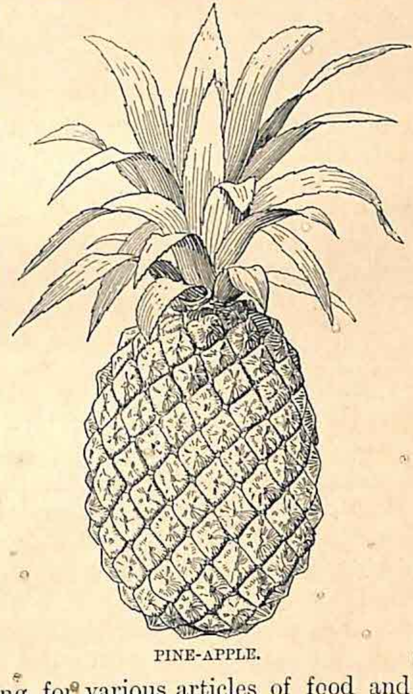
Point out that the European orange is known, as a rule, by its **smooth thin skin,** *and each one comes to us* **rolled up singly in thin white paper.** *The West Indian variety have* **coarser rougher skins,** *and they are usually packed together in bulk,* **without any wrapper.**

The **bitter** or **Seville orange** is chiefly valued for the peculiar oil contained in its rind, from which various tinctures and flavourings are made.

The **Malta,** or **blood orange,** is a seedless variety; and the **mandarin** is a **small flat orange,** which gets its name because it came originally from China.

The orange, like many other fruits, contains very little actual nutriment. It can scarcely rank as a food, but the acid and mineral salts of its pulp and the essential oil of the rind make **it a highly valuable aid to other food.**

The lemon, together with the sweet lime, shaddock, and citron (fruits of the same class), come mostly from Madeira and the West Indies. The juice of these is **more acid** than that of the orange. Lemons are largely used as flavouring for various articles of food and drink.



PINE-APPLE.

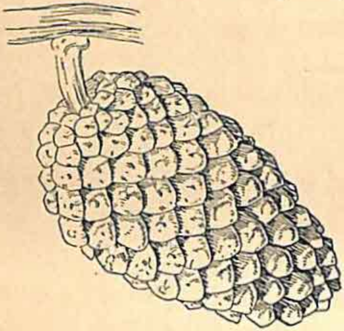
The **pine-apple** is grown mostly in South America and the West Indies.

It is the fruit of a low-growing plant, which in those hot lands is cultivated in the open fields, as we grow other crops here.

The plant consists of a number of **stiff sharp-pointed leaves** springing almost directly from the root, and from the centre of them rises a **short stem bearing a single fruit.**

The fruit itself is highly valued for dessert and preserving, as well as for flavouring purposes.

Explain that the name pine-apple is misleading, as it has no connection with the apple. It is called a **pine-apple** *because it resembles in appearance the* **pine-cone.**



PINE-CONE.

Grapes come mostly from Spain and the other warm countries of Southern Europe. Tons upon tons are sent to us every year packed in sawdust.

They are delicious, wholesome, and refreshing, and are often welcome in the sick-room, when the patient is allowed no other fruit.

Lead the children next to think of the grocer's shop, and they will at once tell of a different class of fruit—**raisins, currants, figs, dates,** *and* **prunes.**

Refer to the lesson in the earlier stage (Vol. i. p. 245) *and lead them to tell the nature of raisins and currants, and the manner in which they are dried.*

Explain that **muscatels,** *the finest variety of raisins, are dried in another way.*

The stalk is partly cut through, and the fruit is allowed to dry **as it hangs on the branch.**

Raisins come from Valencia and Malaga in Spain;

sultanas, a small seedless variety, from Smyrna; and **currants** from Smyrna and the Ionian Islands.

Tell that raisins contain more actual nutriment than any of our fresh or raw fruits. **More than half their weight** *consists of* **sugar,** *and in addition to this, they contain* **a small proportion of flesh-forming material.**

Figs are even richer still in nutriment, for they contain not only **abundance of sugar,** and a certain amount of **fat,** but almost as much **flesh-forming matter** as fine wheaten bread.

Point out that the reason why this fruit cannot be eaten to any extent is that the seeds are liable to cause irritation of the bowel. It is probably for this reason that a fig, taken in the morning on rising, acts as **one of the very best aperients.**

Prunes are **dried plums.** The best and finest are known in the market as **French plums.**

Lesson XXII

NUTS

The teacher should be provided with specimens of the various nuts mentioned, or failing them with pictures of those that cannot be obtained. A few plum and cherry-stones, a hammer, a picture of the cocoa-nut palm, an actual cocoa-nut in the husk if it can be obtained, specimens of cocoa-nut matting, cocoa-nut oil, and marine soap will also be required. The filbert, walnut, and chestnut should be shown, if possible, in the green outer shell.

I. INTRODUCTION

COMMENCE with a simple experiment as follows:—

Crack an almond and a Brazil-nut carefully, so that the kernels may be taken out whole. This done, cut each kernel into the form of a cone, stand it on end, and apply a lighted match to the apex. Both of them will instantly burst into flame, and burn like little candles.

While they are burning do the same thing with a chestnut, and point out that this nut does not burn like the others. Try all we can, it is impossible to make the chestnut flame up.

What is the meaning of this? Let us see.

Take three other kernels similar to the first, put each one between a sheet of writing-paper, and after crushing them up with a hammer, hand the papers round the class for inspection.

What difference do you notice between the papers now? Two of them **look quite wet**—much wetter than the other.

Which are they? Those in which the **almond** and the **Brazil nut** were crushed.

Let us find out what this wet is which we have pressed out of these nuts.

Apply a lighted match to each paper (carefully of course, to avoid accidents).

Point out that in each case the paper **instantly blazes up,** *and therefore the wet cannot be water, for that would have put the light out.*

Tell that it is **oil.** *These nuts contain a large amount of oil; it was the oil in them* **that made them burn**; *it was the oil pressed out of them* **that made the paper blaze up.**

The chestnut would not burn, because unlike them **it is not an oily nut.**

When we crushed it up with the hammer, there was not enough oil pressed out of it to make the paper greasy.

II. NUTS AS FOOD

Compare the almond with the kernel of a cherry-stone or a plum-stone, and show **they are all seeds.** *Tell that* **nuts of every kind** *are the seeds of the plants on which they grow;* **corn and pulse** *are also seeds.*

Let us compare these seeds one with the other.

What is the material which forms the bulk of a bean or a grain of corn? **Starch.**

What is the chief material in all young growing fruit? **Starch.**

What happens to the starch as the fruit ripens? It **changes into sugar.**

How do we classify starch and sugar as foods? We place them with **the fuel-foods.**

So, then, **corn and pulse** are rich in one kind of fuel-food—**starch**; **fruit** is rich in another kind of the same food—**sugar.**

Nuts differ from all these. They contain **abundance of fuel-food,** but instead of starch or sugar, it is **oil.**

Few varieties of nuts (with the single exception of the chestnut) contain less than **50 per cent,** that is half their weight, of **fat or oil.** Some contain much more than this.

In Lesson XVIII. it was shown that all kinds of pulse (ground-nuts excepted) are singularly **poor in fat.** *Remind the children of that now, and compare pulse in this respect with oatmeal.*

These oily nuts are as a rule **very rich also in flesh-forming material**—some of them almost as rich as **peas and beans.** They ought therefore to provide a very nourishing variety of food; but the **large amount of fat** in them renders them **difficult to digest,** and the fat itself is very liable to turn rancid when exposed to the air.

It would be interesting to point out how people have learned by experience to eat **almonds** *and* **raisins** *together as a dessert. The* **almonds** *contain* **54 per cent of fat** *and* **24 per cent of flesh-forming matter.** *In other words, they are rich in the very ingredients in which raisins are wanting.*

The chestnut is in every way an exception to other nuts. It contains **starch** where they contain **oil,** and it is **less rich in flesh-formers** than the poorest of the cereals.

Point this out as the explanation why the people of Southern Europe **mix chestnuts with lupins** *to make their bread material. The chestnut is* **a farinaceous seed, rich in starch**; *the lupin is a kind of pulse containing* **abundance of flesh-forming matter.** *Ground into meal, and mixed together, one supplies exactly what is wanting in the other, and so nourishing food is produced.*

III. KINDS OF NUTS

Among the most familiar nuts are the **filbert, walnut, chestnut, almond,** and **Brazil nut.**

Filberts, hazel-nuts, and cob-nuts, all belong to the same family, and are natives of our own country. The finest variety come from Spain and are known as **Barcelona nuts.**

Show specimens, or failing these, pictures of the growing nut.

The **walnut** is also grown in this country; but in addition we import largely from Germany and the South of France. This nut is the fruit of a magnificent tree whose timber is highly valued by the cabinetmaker.

If the season permit, the nut should be shown **in its green outer case.**

Tell that in their unripe state these nuts **are used for pickling,** *and the green shells of the ripe nuts* **are made into ketsup.**

In countries where these trees are plentiful, **the nuts are pressed for their oil,** *and the people use it for food as they do olive oil.*

The **almond** belongs to the countries bordering on the Mediterranean.

There are several varieties—the **sweet almond,** the **bitter almond,** the **valencia,** and the **Jordan almond.**

Explain that the last-named has nothing to do with the river Jordan.

The name is a corruption of **jardin,** *the French word for* **garden.**

The **chestnut** is the fruit of a very large, handsome, wide-spreading tree. It grows **in a green prickly case,** which splits into four as it ripens. *Show one if possible. Compare it with the* **horse-chestnut**—*a bitter variety of the same family, which is not fit for human food although it is used for feeding cattle, sheep, and swine.*

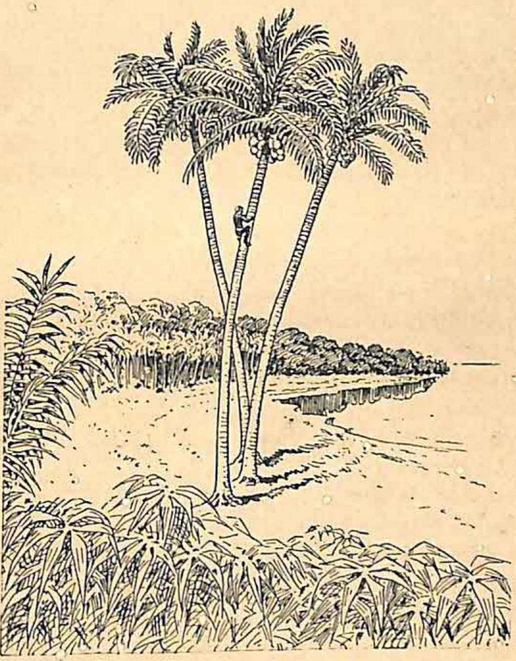
We eat chestnuts **raw** and **roasted,** and they are very wholesome.

We import these nuts largely from Holland and Belgium.

The **Brazil nut** is the fruit of a large tree which grows mostly in the region near the Orinoco. The fruit is a smooth round case, half as big as a man's head, and in it the **three-sided nuts** are packed closely together, as many as **twenty or thirty in each case.**

The most wonderful nut in the world is the **cocoa-nut.** This is the fruit of one of the most useful of the tropical palms—**the cocoa-nut palm.**

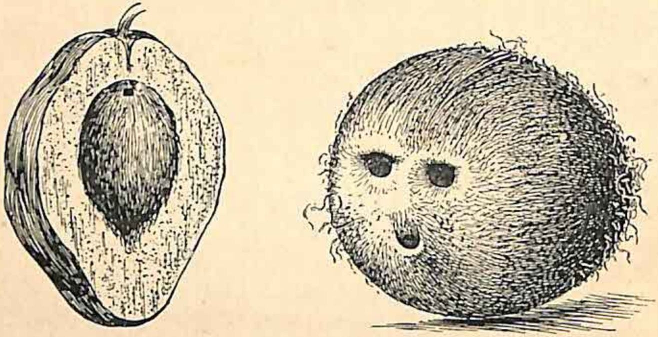
Show a picture of the tree. Tell that it is a stately palm



rising often to the height of **100 feet** ; *its summit is crowned with* **long graceful feathery leaves,** *from* 12 *to* 15 *feet in length. The tree usually bears* **about 60 nuts** *each year.*

Show one of the nuts as they are commonly seen in the shops, and compare it with another in its **thick fibrous outer case or husk.** *Tell that this husk provides the material from which* **cocoa-nut matting** *is made.*

Explain that the name cocoa-nut has nothing to do with the beverage-making material—cocoa. It is derived from a Portuguese word **coco,** *which means* **an ugly face.** *The name was given because of the peculiar marks at the broad end of the nut,* **which seemed to resemble the face of a monkey.** *Show these marks.*



This tree is invaluable to the natives of the lands where it grows. The nut itself provides an important part of their food; the milk in it supplies them with a drink; the timber (porcupine wood, it is called) builds their houses; and the broad leaves provide the material for thatching them. Indeed the uses of this tree are said to be as numerous as the days in the year.

The nuts are used in this country to a somewhat considerable extent **by the confectioner** in making **cakes** and **sweetmeats** of various kinds, although it must be admitted that they are **fibrous** and **indigestible.**

We import them chiefly for the sake of their oil—**cocoa-nut oil**—which is used in making **marine soap,** the only kind of soap that will form a lather in sea-water.

SECTION II.—CLOTHING

Lesson XXIII

THE NATURAL HEAT OF THE BODY

The teacher will require two or three thermometers 212° (tubes only), the Bunsen burner, a flask and a retort-stand, a large basin, some ice, a clinical thermometer, and some water.

I. Introduction

Commence with a brief reference to the foregoing lessons on food, and then elicit from the class that food is not the only thing the body requires to keep it healthy. It must have clothing. Tell that clothing is to be the next subject to claim our attention, and proceed in some such way as follows to show how closely the two things are connected.

What names do we give to the two chief classes of food-stuffs? **Flesh-formers** and **fuel-food.**

What is the use of the flesh-formers? They build up all parts of the body.

What kind of substances are fuel-foods? **Starch, sugar,** and **fat.**

What is the use of these things in the body? They are **burnt up as fuel.** The heat from this burning **warms the body,** and **produces vital energy** to enable it to work.

Do people in all parts of the world eat the same fuel-foods? No; **in cold lands** they eat fat, **in hot lands** starch and sugar.

Why is this? Because in hot lands **fat would make the body too hot**, and in cold lands **starch and sugar would not give out heat enough** to make it warm.

So, then, by eating a suitable kind of fuel-food people in all parts of the world are able to keep the body **just as warm as it ought to be.** Now let us think of the different kinds of clothing they wear, and we shall see that this serves exactly the same purpose.

Lead the children to tell why it would be as impossible for the Hindoo and the negro to live if they clothed themselves in the furs of the Esquimaux, as it would be for the Esquimaux to live with nothing but the thin scant covering which those people wear.

In the one case the body would get too hot, in the other it would quickly perish with the cold. By wearing **suitable clothing,** as well as by eating **suitable food,** people in all parts of the world are able to keep the body at its proper heat—its proper **temperature.**

Now let me show you what we mean by the proper temperature of the body.

II. THERMOMETERS.

Produce one of the common thermometers, and lead the children to tell all they can about the instrument, assisting them of course where necessary. They have already experimented with it in a simple way in the third stage.

Elicit now the meaning of the name **Thermo-meter**; *it measures the heat* **by the rise and fall of the mercury** *(quicksilver) in the tube.*

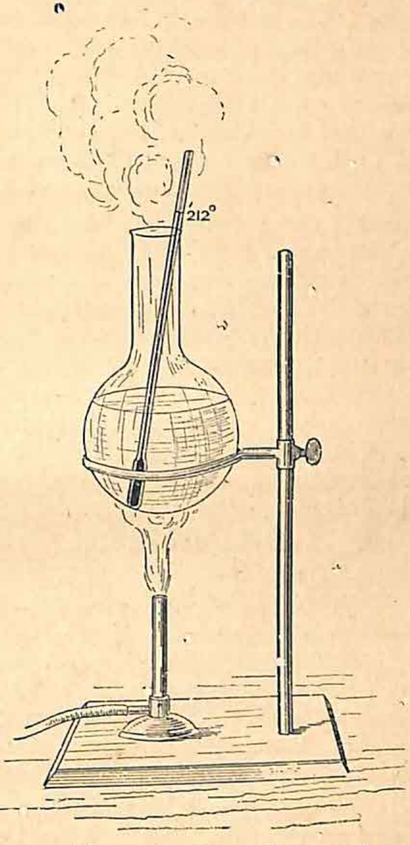
Call upon them to tell what happened when the instruments were placed, one in melting ice, the other in the steam of boiling water.

Repeat the experiment now with two instruments, to show the **freezing-point** *and the* **boiling-point.**

Call attention to the figures marked on the tube. Point out *that in one instrument the top of the thin line of mercury rests* **exactly opposite the figure 32.**

Tell that **water always freezes** *when the mercury in a thermometer reaches this point. We call it the* **freezing-point.**

Turn now to the other instrument in the flask of boiling water, and point out that the top of the mercury in this one is **exactly opposite the figure 212.** *All can see that the water in the flask is boiling. Tell that* **water always boils** *when the mercury in the thermometer reaches this point. We call it the* **boiling-point.**



Subtract 32 *from* 212, *and show that the difference is* 180, *and then let the children observe for themselves that the space on the thermometer between the freezing-point and the boiling-point is marked out in* **180 equal steps, like the steps of a ladder.**

Show that these steps tell exactly how much the mercury in the tube rises and falls, and so we learn the exact heat of things.

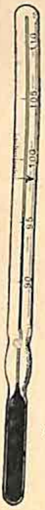
We call them **degrees,** not **steps**; but the **two words mean the same thing.**

Water freezes when the mercury stands **at 32 degrees,** and **boils** when it stands **at 212 degrees.** The mercury rises **step by step** from one point to the other.

It will interest the children if one of them is called upon to take the thermometer out of the ice and hold the bulb in her hand. They will all see the mercury **rising step by step,** *as it receives the warmth from her hand, and they will thus form a clear conception of the two words* **steps** *and* **degrees.**

This done, let another girl examine one of the instruments that have been lying on the table. Tell that this one shows the **exact heat,** *or* **temperature, of the air of the room;** *and prove that it does so because the other which has been lying beside it points to exactly the same figure*—55 *or* 60 *degrees, as the case may be. Take the thermometers in either hand, and let the children observe how quickly* **the mercury rises step by step** *as the hand closes round the bulb.*

What does this tell us? It tells us that **the hand is warmer than the air** of the room.



Produce now the **clinical thermometer.** *Elicit that this little instrument is only used for measuring the heat or* **temperature of the body.** *Explain that this is the reason why it has no marks on it to show either the freezing-point or the boiling-point. It is only graduated* **from 90 to 110 degrees,** *as the body never gets colder or warmer than this.*

Place the bulb of the instrument in the mouth of one of the girls, just under the tongue, and let it rest there for a few minutes, and when it is taken out, call upon the class to read the figures (98), *which stand* **nearly at the top of the column of mercury.** *Tell that this shows that the heat of the girl's mouth measures* **about 98 degrees.**

What name have we already learned to give to this point in the thermometer, which we now see is marked 98 degrees? We call it **blood-heat.**

What does that mean? It means that the heat or temperature of the blood in all parts of the body **measures 98 degrees.**

Explain that this warm blood, constantly coursing along, acts **like the hot-water pipes** *of a large building, and warms the whole body.*

The natural heat, or temperature, of our bodies, which comes from the burning of the fuel-foods, is always about 98 degrees, and **this temperature must be kept,** if we are to be well and healthy.

Compare this **blood-heat** *with the temperature of the room, and with the heat of boiling water.*

III. Blood-heat

Picture a number of children at their play. They run and romp about, till **their red faces** *tell how hot their bodies are all over. They are over-heated with the hard work of their games, just as men and women get over-heated with actual work.*

What tale do you think the thermometer would have to tell if it were put into their mouths then?

This, of course, will be a puzzle to the children. After exciting their curiosity, tell them that the **thermometer would even then stand steadily at blood-heat**—*a little above* 98 *degrees.*

How can this be, for the body feels much hotter than it usually does?

Lead the children to tell what they notice if they place their hand on any part of the body at such a time. **The skin everywhere feels wet with perspiration,** *or sweat. They can see it* **steaming away** *from their bodies in* **vapour.**

Remind them that **nothing but heat** *can change water into vapour, whether it be in the kettle, in the boiling flask on the table, or in our own bodies.*

Explain that **all the extra heat,** *which is produced when we exert ourselves in any way,* **is used up** *in changing this perspiration into vapour, and so* **the blood itself does not get over-heated**—*the thermometer still stands at* 98 *degrees.*

Lead them to tell that the body naturally gets heated much more rapidly in the hot weather than in the winter. We *cannot sit in a hot room without feeling the effect of it. The body begins to get over-heated, and then* **the perspiration at once oozes out** *through the skin, to help the body to get rid of some of the heat.*

This is Nature's way of cooling the body when it is over-heated; and it explains why it is that even **in scorching tropical lands** the thermometer tells the same tale if it is put into the mouth of a healthy person. **The blood-heat of the body even there is 98 degrees.**

Explain, on the other hand, that in the coldest winter weather the thermometer **still points to 98 degrees** *if it is placed in the mouth of a healthy person, who is* **well fed** *and* **well clothed.** *It would stand at exactly the same point if placed in the mouth of* **a healthy Esquimaux,** *in spite of the piercing cold all round him.*

Blood-heat in the healthy body **is blood-heat all over the world,** and measured by the thermometer it is always **about 98 degrees.**

When one **falls ill,** the first thing that happens is **a change in the temperature** of the body. The amount of change can be readily tested by placing the thermometer either **in the mouth** or **under the arm-pit.**

If the mercury marks either **more or less** than 98 degrees, it shows that the temperature of the body is **too high** or **too low,** and something must be done at once to bring it back to the natural healthy blood-heat.

Lesson XXIV

HOW THE BODY LOSES ITS HEAT

Provide for illustration a small jug, a kettle of boiling water, a small bar of iron, pieces of marble, stone, brick, and wood, a woollen glove, a ball of wool stuck full of pins, and an iron ball fitted with a chain for hanging purposes.

Before the lesson commences, put the iron ball into the middle of the fire, which should be bright and red.

I. INTRODUCTION

FILL a jug with boiling water from the kettle, place it on the table in front of the children, and let them tell what will happen to it if it is allowed to stand there for some time.

The heat will gradually pass away from the water, till it is left quite cold.

Take the red-hot poker out of the fire, and remind them that the same thing will happen to that when we stand it aside.

The heat will gradually pass away; the poker will, after a time, be cool enough to handle.

Tell that, like the water and the poker, everything that is heated **gradually parts with its heat,** *and becomes cold again.*

The body is heated by the burning of its own internal fires, but like everything else **it is constantly parting with some of its heat.** We will now try to find out how all this happens.

II. BY PERSPIRATION

Remind the children of what was said in the last lesson in connection with the skin and perspiration.

When do we notice the perspiration on the skin? When the body is very hot.

What does it look like then? It stands in **little round beads** of water on the skin.

What becomes of it? It steams away in **vapour** into the air.

What is necessary to change these drops of water into vapour? **Heat.**

Where does the heat come from? **It is given off by the body.**

Is this loss of heat through the perspiration good or bad for the body? Good.

Why? Because **it helps to cool the body** when it is over-heated, and so the natural temperature of the body is maintained.

Picture a horse tugging a heavy load along. If we touched his body we should find it very hot and very wet, and clouds of vapour would be seen steaming up from it. **His body is parting with its heat very rapidly then.**

Explain that this perspiration from the surface of the body **goes on at all times** *and not only during violent exertion. Whenever we place our hand on any part of our body we find it* **soft, smooth, supple,** *and* **slightly moist.** *This is because moisture is constantly oozing through the skin, although we do not notice it.*

Tell that at such times the body is said to **perspire,** *and the moisture on the skin properly speaking is described as* **perspiration.** *The* **round beads of moisture** *which stand on the skin after great exertion are distinguished as* **sweat.**

Point out that the reason why we do not notice the perspiration on the skin is that **it disappears in vapour** *as rapidly as it oozes through; and show that, as vapour can only be produced by heat, this constant evaporation from the skin* **must rob the body** *of much of* **its natural heat.**

III. By Conduction

Call upon one of the girls to come to the front and pick up the iron bar that lies on the table. Tell her to grasp it firmly in her hand, and then let her explain in her own way what she observes.

The iron felt **cold at first**; after she had held it for a time it seemed to be getting **warmer.**

That will, no doubt, be quite sufficient to carry the memory back to the lesson in the former stage, where this subject was introduced. Proceed in some such way as this:—

Why did the iron feel cold at first? Because the moment the hand touched the iron, **it lost some of its heat.**

Why did the iron take heat from the hand in this way? Because it is **a good conductor** of heat.

Do you know any other substances besides iron, that would act in the same way? **All the metals** would take away heat from the hand as soon as it touched them; they are all **good conductors of heat.**

Have the pieces of **marble, stone, brick,** *and* **wood** *tested in the same way. The* **brick** *does not feel so cold as the* **stone** *or* **marble**; *the* **wood** *not so cold as the* **brick.**

Lead the children to explain the meaning of this. All these things are conductors of heat; they take away some heat from our bodies when we touch them. But **brick is not such a good conductor** *as stone or marble, and* **wood is not so good a conductor** *as brick.*

Let the girl put a woollen glove on her hand, and take up the iron bar again. She will say, of course, that the iron does not feel cold now.

Why is this? **Wool is not a conductor** of heat. It prevents the heat from passing out from the hand into the iron. The iron does not feel cold when we touch it.

This will be quite sufficient for the present, as conductors and non-conductors will be dealt with more fully in the next lesson. All that is necessary here is to show that **conduction** *is another means* **by which the body parts with its heat.**

IV. By Radiation

The iron ball is in all probability red-hot by this time. Take it out of the fire and hang it up by its chain, in such a position as to enable a group of girls to stand round it in a ring. Each one will tell that **she feels the glow of heat** *from the red-hot ball on her face.*

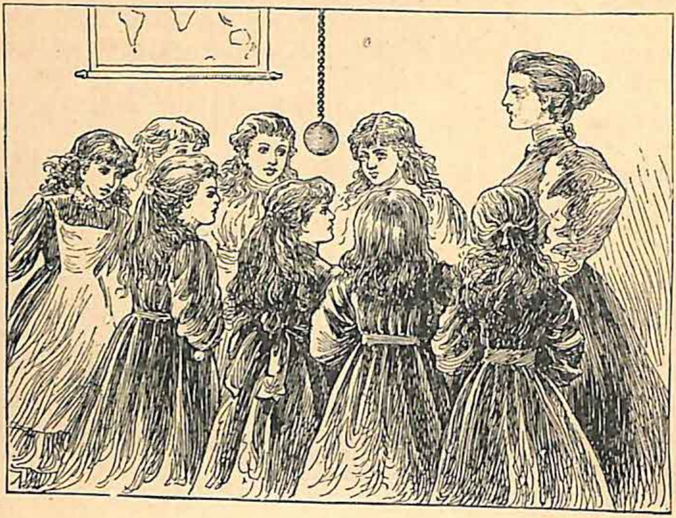
Explain that from every part of the surface of the ball **direct lines** *or* **rays of heat** *are passing through the air till they strike upon their faces. We say that heat is passing from the ball by* **radiation.**

This may be graphically illustrated by means of **a large ball of wool, stuck full of pins** *all pointing to the centre.*

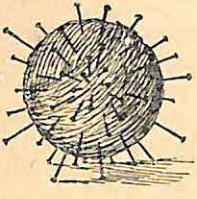
Prove too that the rays travel only in straight lines, by letting each of the girls hold up in front of her a drawing-board, or some similar object, to intercept them. **She no longer feels the heat.**

Why not?

When we are cold we stand in front of the fire to warm ourselves, because the heat from the fire is **radiated towards us,** but if a screen were placed between us and the fire we should feel none of the warmth.



Illustrate this further by referring to the rays of heat from the sun. The sun is an enormous ball. It is the source of all the heat which comes to us. **It warms our earth by radiation.** *The heat passes from it to us in straight lines or rays. We may often feel very warm* **in the direct rays** *of the sun, but if we screen the rays from us in any way, we no longer feel the warmth.*



Point out that the redness has now died away from the ball. It is parting with its heat rapidly. It will presently be cool enough to handle. But all that heat is passing away into the air in **rays** *or* **straight lines**; *the ball will continue to give* *up its heat* **by radiation,** *till it reaches the* **temperature of the air** *all round it.*

Tell that if the ball had been hung up in the cold keen air outside, it would have parted with its heat much sooner. Radiation would have gone on much more rapidly. **The cold air would have robbed the ball more quickly of its heat** to make it cold too.

Let us now leave the ball, and turn our attention to our own bodies.

What is the natural healthy temperature of the body? About **98 degrees.**

Is the air around us warmer or cooler than that? Cooler. In winter it is often much below the Freezing Point (32 degrees).

Lead the children to deduce from what has been said, that the cool surrounding air acts upon our bodies, just as the air acted on the hot ball. It robs them of heat by radiation, and the colder the air the more rapid the radiation. **Radiation,** *then, is another way* **in which the body loses its heat.**

Lesson XXV

CONDUCTION OF HEAT

For illustration have in readiness a few small brass balls, one of which should be provided with a chain. Put them in a sauce-pan of boiling water, and before commencing the lesson, take some of them out of the water with a spoon, and in presence of the children wrap each one up in a separate wrapper of fur, flannel, woollen cloth, feathers, silk, calico or linen, and let them lie on the table before the class. The following articles will also be required:—a couple of tin dishes, specimens of all the fabrics mentioned in the lesson, a tea-cosey, and a white linen cover similar to it in shape, and two small teapots. Fill the teapots with boiling water before commencing the lesson, and put the two covers over them.

I. INTRODUCTION

TAKE the three remaining balls out of the hot water. One of them is to be hung up in front of the class, and should be provided with a chain for that purpose.

Place the second on one of the tin dishes, and wrap the third up close in a piece of fur, and put it on the other dish.

Point out that all these balls are very hot now, for they have just been taken out of the boiling water; and then lead the children, step by step, to tell what is going on.

We can learn something from these hot brass balls. Let us begin with the one that is hanging up.

What is taking place in this ball? It is **giving up its heat** to the air all round it.

Why does it do this? The air is cooler than the ball and **robs it of its heat.**

How does the heat pass away from the ball? In **straight lines** or **rays.**

How do we describe it? We say the ball loses its heat **by radiation.**

When will it cease to radiate its heat into the air? When it is **as cool** as the air itself.

Now let us turn our attention to the ball that is lying in the tin dish. This of course is also radiating some of its heat into the air; but I want to show you that it is parting with heat in another way besides that.

Call upon one of the girls to come to the front and take the dish in her hands.

She will quickly find that **the dish itself is quite warm.**

The heat which has warmed the dish can only have come from the hot ball, for the dish was cold when we laid the ball on it. The cold dish began to rob the ball of its heat as soon as the two things touched each other.

How do we speak of this? We say the heat is passing away from the ball **by conduction**; it is being **carried** or **conducted** away by the tin dish.

When will this cease? When the ball and the dish are **at the same temperature.**

Proceed next to examine the third ball. Set one of the girls as before to take the dish itself in her hands, and she will at once notice that this dish is **not warm** *like the other.*

Tell her to remove the ball from the fur wrapper and take it in her hands.

When she does so she will drop it at once, for she will find it **too hot to hold.**

Why is this ball still hot? The fur **has kept the heat in,** and prevented it from escaping.

Point out that the heat could not get through the fur either to escape by radiation into the air, or to make the tin dish warm.

The other dish became warm because it carried or conducted the heat away from the ball. We say it is a good conductor. We call the fur **a bad conductor** or **a non-conductor,** because **it prevented the heat from passing away** from the ball.

In our last year's course we had another experiment with these heated brass balls. We wrapped one in flannel, the other in calico.

Which of those wrappers acted like the fur in preventing the heat from escaping? The **flannel.**

Why? Because **flannel** is **a bad conductor** of heat.

What happened to the ball which was wrapped in calico? It soon became cool.

Why? Because **calico** is **a good conductor,** and allowed the heat to escape.

We will repeat the same experiment now in a somewhat different form.

II. GOOD AND BAD CONDUCTORS

Call attention to the other balls which have been lying on the table in their wrappers until now. Remind the children that they saw them taken out of the hot water; and then proceed at once to have them examined one by one.

The children will find :—

(1) *That the* **one in the linen is all but cold**—*it has lost nearly the whole of its heat.*

(2) *That the other* **wrapped in calico is cool enough to handle,** *but not so cold as the first. It has not parted with so much heat.*

What do we learn from this? We learn that linen and calico are both **good conductors,** but linen is a better conductor than calico, **because it allows more of the heat to pass away.**

Deal in a similar way with the other wrappers—fur, flannel, woollen cloth, silk, and feathers—and elicit that these are all **bad conductors.** *They prevent the heat from passing away. Fur keeps in more heat than any of the others.* **It is the best of the bad conductors** *in this respect.*

Lead the children next to tell that when the hand is laid on these various materials, some seem to **strike much colder than others**—*linen is colder than any of them.*

Elicit further that this is not because one material is really colder or warmer in itself than another, but because one is a good, the other a bad conductor.

The **good conductors feel cold** *because they rob the hand of its heat immediately it is laid upon them. The bad conductors do not allow the heat of the hand to pass away, and so* **they feel warm.**

How did we prove that none of these materials are warmer in themselves than others? By wrapping a thermometer in each of them.

What did the thermometers show? They all showed exactly the same temperature. There was **no more warmth in one material than another.**

I will now prove to you that there is no real warmth in any of them—even in fur, the one that feels the warmest of all.

I have a stone here, which I found in the garden and wrapped up close in this piece of fur. It was quite cold when I put it into the fur. Let us see whether it is any warmer now, for it has been wrapped up close for a long time.

Take it out of the fur, and let the children handle it. It is as cold as when **it was put into the fur. The fur has not made it warm.** *It has really kept it cold.*

Explain that the air of the room is warmer than the stone, and if there were nothing to prevent it the stone would have been taking away heat from the air all this time to make itself warmer.

The fur, however, is a bad conductor; it will not allow the heat to pass through, and so **the thick fur,** *which kept the ball hot,* **has actually kept this stone cold**—*and for the same reason.*

Explain that on the same principle ice merchants **wrap their ice in thick blankets**—*not to keep it warm, but* **to keep it cold.**

III. CLOTHING MATERIALS

Call attention now to the tea-cosey, which has been standing on the table during the lesson. Remove it and show the teapot, which was filled with boiling water before the lesson began.

The water is still hot; it has lost very little, if any, of its heat. **The woollen material of the cosey is a bad conductor**; it will not let the heat escape.

Turn next to the other teapot, which has been covered up with a similar sort of cover, made of **white linen**; *and let the children observe the difference for themselves.*

The water in this pot was as hot as that which was put into the other. It is now scarcely warm; nearly all its heat has passed away, because **linen is a good conductor of heat,** and has conducted or carried it away.

By substituting our own bodies for the teapot, it will now be an easy matter to bring home to every child's perception the real purpose of the various clothing materials. Let them explain this in their own way.

The animal substances—fur, wool, silk, and feathers—are for the express purpose of keeping the body warm, because being **bad conductors,** like the tea-cosey, **they prevent the bodily heat from escaping.**

Cotton and linen materials, on the contrary, **keep the body cool,** because they are good conductors, and **allow some of the heat to escape** into the air.

Lesson XXVI

MATERIALS FOR CLOTHING

The teacher should be provided with half-a-dozen small, shallow saucers, a basin, hot and cold water, a thermometer, a piece of looking-glass, a picture of some African savage, and specimens of all the fabrics named in the lesson.

I. THE VALUE OF FLANNEL

COMMENCE by reminding the children of the important work of perspiration, which is always going on from the surface of the body.

Lead them to tell the useful purpose it serves in carrying off the excess of heat from the body.

Why is it that even after the body has been over-heated by violent exertion, the thermometer still shows only a temperature of 98 degrees, or blood-heat? **The extra heat,** produced by the extra work, **is used up** in changing the perspiration, which is thrown off, into vapour.

N.B.—*This is a most important fact, and cannot be too much impressed upon the children. It is the keynote to what is to follow.*

Put a little water in the bottom of some shallow saucers or plates, and lay in each a piece of one of the textile fabrics— **linen, calico, flannel, cloth.** *Let the children see that in each case the water soaks into the material.*

Why is this? All these materials are porous; **they absorb the water into their pores.**

Take them up one by one, and wring the water out of them.

Picture men and women at their work, and children romping about in their games, till they get over-heated. The perspiration begins to ooze out through the skin, making it quite wet.

The body does not remain wet very long. Why is this? Because **the perspiration is soaked up** by the porous materials of the **underclothing.**

Fill a basin with water at about the temperature of blood-heat.

Stand a small thermometer in it so that the children may read the temperature for themselves.

Now put a piece of flannel, linen, and calico into the water, and when the materials have become well soaked, wring them out, and let one of the girls place her hand on all three in succession.

What do you observe? The **flannel feels warm**; the others are **cold and clammy** to the touch. Vapour is rising from all three materials.

Why is this; they all came out of the same water? Flannel is a non-conductor; **it does not readily part with its heat.** The others are good conductors; they soon lose their heat. The linen is even colder than the calico.

Now let us see what all this has to do with our clothing.

It proves to us that the garment next to the skin should always be made of flannel, or some other woollen material, for although it is porous, and allows the vapour of the perspiration to pass away, it is also a **non-conductor** and **prevents the heat from escaping.** It never strikes cold and clammy—**the body never feels a chill.**

Cotton and linen materials are porous too; they allow the perspiration-vapour to pass away. But they are good conductors, and **they allow the heat to escape as well.** That is why these wet garments **strike with a chill** on the skin, and give rise to colds and other disorders.

The teacher would do well at this point to give the children some sensible advice on this all-important matter. Tell that a good flannel under-garment is **better than a cloak or great-coat** *without it, for the cloak may be laid aside or forgotten when it is most needed, but this protecting under-garment is there at all times.*

Point out the wisdom of wearing a flannel under-garment of some sort **in the summer** *as well as in the winter, because we are more likely to get over-heated and* **perspire freely** *then than in the cold weather.*

Tell that our army and navy authorities compel all their soldiers and sailors to wear flannel next to the skin in hot as well as in cold climates.

Some people are ready enough to put on flannels when winter comes on, but they very unwisely discard them at the return of the warm weather.

Remember, it matters very little how thin and loose the texture of the summer skin garment is, **provided only that it is made of some sort of woollen material.**

II. Dark and Light-Coloured Clothing

Here is a little experiment, which you can perform for yourselves the next time you see the snow lying on the ground. We cannot of course do it now.

Take two pieces of cloth—one a dark, the other a light-coloured material—and lay them on the snow, side by side, some day when the sun is shining.

We often see the sun shining brightly, you know, even when the snow is lying on the ground.

If you watch, you will find that **the snow under the dark-coloured cloth will soon begin to melt,** *although that under the other piece will remain unchanged.*

Why is this? It is not because there is any difference in the material, for they are both woollen cloth.

It is not because one material is warmer than the other, for you know that **none of these materials have any warmth** of their own.

Explain that it is all due to the **colour of the cloth. Dark-coloured materials** *always* **absorb the rays of heat** *from the sun;* **light-coloured** *ones* **reflect the heat** *or throw it back.*

The idea of reflection may be simply and graphically illustrated by means of a piece of looking-glass held in the rays of *light, so as to form a Jack-o'-Lantern. This throws the light back on the ceiling, but the rays pass through a sheet of ordinary glass.*

Dark-coloured, non-conducting materials are best for winter wear, **because they are good absorbers of heat,** although they take good care not to let any of the bodily heat escape.

A person is always warmer in a black dress than she would be in a white one.

In the **summer-time** the dark-coloured, thick, non-conducting materials give place to **bright colours** and **white cotton dresses.** Why?

In connection with this, point to the almost universal white clothing, which is worn in tropical lands, and to the white scarves which are sometimes worn round the hats here in very hot weather.

III. CLOTHING FOR PERSONAL ADORNMENT

This part of the subject might be very well introduced by showing a picture of one of the native savages of some tropical land in full dress.

Point out that these people have no need of clothing to protect them from the rigours of the climate. They clothe or rather dress themselves merely **for personal adornment.**

A girdle of plaited grass or reeds, with a plentiful show of coloured beads, shells, or feathers, and a few rings hanging from the nostrils and ears, or encircling the ankle and wrist, is the height of fashion for them.

The teacher should not lose this opportunity of pointing out *the* **almost savage instincts,** *which are shown by some of the girls to be met with here in our own country—not actual black savages, but* **English girls.**

Too strong language can scarcely be used in exposing to ridicule those people who, in order to get **tawdry, showy finery** *for outside show,* **deprive themselves of the good useful under-garments,** *which are so necessary for their health and well-being.*

Point out to the girls, on the other hand, that it is every one's duty to study personal appearance. Picture **a neat, tidy, well-dressed girl** *by the side of one who is got up for gaudy show. The probability is that the one is clean, wholesome, and healthy, while the other,* **in spite of the outside show,** *is exactly the reverse.*

Lesson XXVII

ERRORS IN CLOTHING

Provide for illustration pictures of the skeleton, one showing the ribs in their natural state, the other showing the same distorted by tight-lacing, and similar pictures showing the internal organs in a healthy natural state, and also distorted from the same cause.

I. INTRODUCTION

WE have discussed the various materials used for clothing. Let us now turn our attention to the articles of clothing themselves, which are made from these materials for our daily use.

In dealing with this part of our subject, we must again think of the body as a wonderful piece of machinery, capable of performing an immense variety of wonderful functions, but, like all other machinery, easily thrown out of its proper working order by bad management.

Remember how essential food is to our daily life. Yet some people ruin their health and shorten their lives

through nothing else but eating and drinking. They do not eat and drink in the proper way.

Clothing is as essential to us as food; but **if the articles worn are unsuitable,** even the clothing becomes a source of discomfort, and often of actual disease to the body.

I have already shown you that personal adornment has, and must have a great deal to do with the choice of our clothing, because we all like to look our best.

New styles or fashions of clothing are constantly springing up, and many people are apt to pay more attention to fashion **than to common sense.** It is in this way that **serious errors are often made,** and it is against these errors that I must now warn you.

II. TIGHT CLOTHING

Point out that one of the most important things to remember in connection with our clothing is that it must cover and protect the body **without unduly pressing upon it** *or any part of it; for if this wonderful machine is to perform all its work well, it must have perfect freedom for all its movements*—**it must not be cramped or squeezed in anywhere.**

Take as an illustration of this any of the familiar animals around us.

Nature clothes them, but **their clothing does not cramp and squeeze their bodies in,** *and if we would be healthy and strong we must* **follow Nature's example** *in clothing ourselves.*

I put on a pair of tight gloves, and my hands are actually **colder** than they would be if they were uncovered. Let us see why this is.

What happens if you prick the skin on any part of your body with a needle? It bleeds.

What does that prove? There must be **blood in every part of the body.**

Why does the blood flow out? Because the needle pierces some of the little **blood-vessels** just under the skin

What are these blood-vessels? **Little pipes**—some of them as fine as hairs.

How does the blood get into these pipes? It is **pumped** through them **from the heart.**

Why does your hand feel warm now? Because the warm blood from the heart is flowing through those little blood-vessels. It is **the warm blood that makes the hand feel warm.**

What would happen if these vessels were closed up? The **blood would not be able to flow** through them.

And what would be the result of that? The hand would get cold. There would be **no warm blood** there **to keep it warm.**

It will be an easy matter now to lead the children to tell why the tight glove makes the hand cold **by stopping the circulation of the blood.**

Point out that what is true of the hand is equally true of other parts of the body.

Tight boots, *for exactly the same reason, are a certain cause of* **cold feet,** *and in the winter this* **stoppage of the circulation** *frequently results in* **chilblains.**

Tight garters are very injurious. They press upon the blood-vessels of the legs, and by interfering with the circulation are almost always the cause of **varicose** or **swollen veins,** which will be a source of great trouble in after-life.

It would be well, while speaking of this, to hint that nothing gives a girl a more slatternly appearance than to have her stockings hanging loosely about her legs. Suspenders are, for many reasons, better than garters.

Tight sleeves should also be avoided. Besides interfering with the circulation they also **interfere with the freedom of the muscles** of the arms and chest.

III. TIGHT-LACING

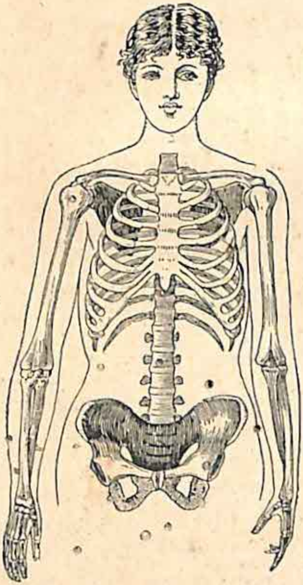
Fashion, with its errors in dress, has always had more victims among women than among the opposite sex, and its most pernicious error is **a small waist.**

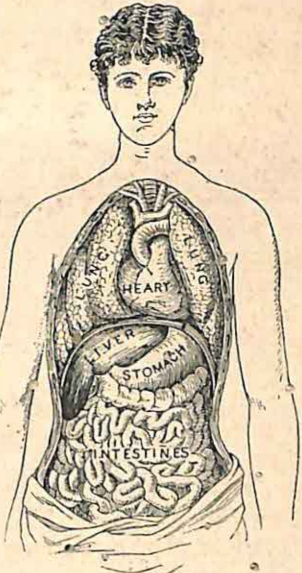
For some unaccountable reason fashion declared a small waist to be a mark of beauty, and women of all classes are often found unwise enough **to follow fashion in spite of common sense.**

Those who are not naturally slender in build **endeavour to make themselves so,** in defiance of Nature, with the help of **stays and corsets** many sizes too small for them.

Let me show you the result of this suicidal practice, and I hope it will serve as a warning to all of you.

Show a picture of the skeleton. Call attention to the bony cage—**the chest**—*formed by the* **twelve pairs** *of long curved* **ribs,** *which spring from the spinal column, stretch*





round to the front of the body, something like **hoops round a cask,** *and meet in front.*

Point out that where so much protection is provided, there must be something very important to protect, and then call attention to the other picture showing the **organs inside this strong bony cage.**

Show that the **two lungs,** *with the* **heart** *between them, take up the whole of the space, and lead the children to tell in a simple way the work of these organs. The* **breathing work** *of the lungs, and the* **pumping work** *of the heart, are so important that they* **never stop** *for a moment, sleeping or waking.*

Point out the other important organs—**stomach, liver,** *and* **intestines**—*which occupy the space below, and elicit from the children that these have to do the* **work of digesting the food.**

This is a picture of the inside of our body as it ought to be. Now let me show you another picture of what tight-lacing does for people.

Call attention, in the first place, to the bony cage of the chest, and compare it with that in the other picture. In this case the **ribs are pressed in** *and distorted, so that the* **space inside is very much smaller** *than it ought to be.*

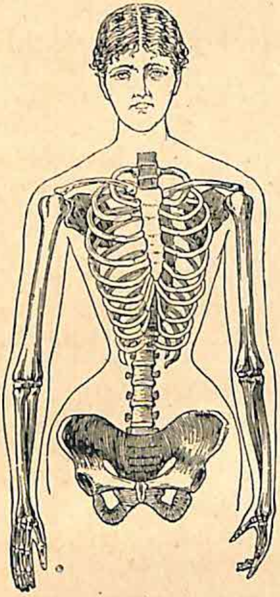
Point out that if the chest itself is pressed in and distorted, those delicate vital organs inside—the **heart** *and* **lungs—must be cramped up for room,** *and distorted too, and then show the actual state of these organs in the picture.*

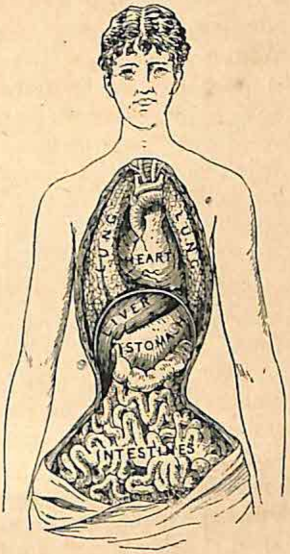
It is important to remember that the mischief does not end with the heart and lungs, for a glance at the other organs will show that liver, stomach, all of them are forced **out of their natural positions,** and so cramped up for room that **it is impossible for them to do their work** properly.

Now let us notice some of the results of this baneful practice.

(1) **The organs of digestion are prevented from doing their proper work,** and the food, instead of being digested or changed into blood to nourish the body, is to

a large extent wasted. The body is racked with the pains of **indigestion** after every meal; it **does not get its proper nourishment** and support from the food, and as a consequence it gradually gets **weaker and weaker.**





(2) The unnatural pressure on **the heart** interferes with its work of pumping, and **a weak circulation follows,** so that even the small amount of nourishment which it gets from the food is **not carried regularly round the body** as it ought to be, and this is another source of weakness.

(3) Those delicate organs, **the lungs,** are so cramped up for room that they not only get **distorted** in shape, but also **dwindle** in size, and grow **weaker** and **weaker** till at last **active disease** sets in.

In a word, these deluded women get in return for their waspish waist, a life of torture, and an almost certain death at an early age from the cruellest of all scourges—**consumption.**

If fashion calls for a small waist, think what a terrible price must be paid for it. **Avoid fashion,** and **listen to common sense.**

Remember, stays and corsets are not necessary articles of clothing at all. But if they are worn, **they must never be laced after they are put on,** and they should never be so small as to require to be unlaced before they can be taken off.

Lesson XXVIII

CLOTHING AND COMMON SENSE

Articles required for illustration: a lady's fashionable boot (new if possible), a picture of a natural foot, and of one distorted through improper boots, two square tin boxes, one measuring an inch, the other two inches as described below, a kettle of boiling water. Fill the boxes with boiling water from the kettle, and hang them up before the class.

I. COMMON-SENSE BOOTS

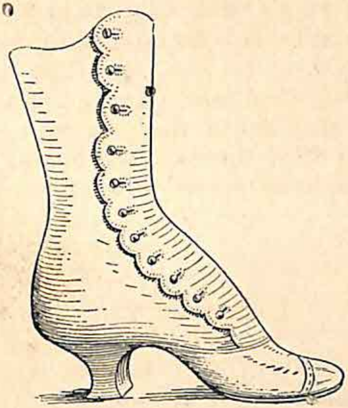
Show a lady's so-called fashionable boot, a new one from the shop if possible, and proceed in some such way as this:—

In very few things do people more frequently show a want of common sense than in the choice of their boots and shoes, and as a rule girls and women act more foolishly than men in this respect.

That is why I intend to begin our lesson to-day with an examination of this boot.

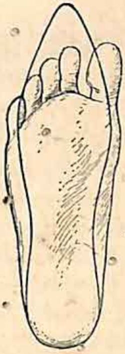
It is a lady's **fashionable boot,** such as you may see in the shop windows. It looks very neat, very smart, very pretty in shape, and yet it is in many ways the **most unsuitable covering for the feet** that has ever been devised. Let us examine the boot, and find out what is wrong with it.

Call attention, in the first place, to the **sole.** *Notice that it is* **very narrow,** *and* **very pointed** *towards the toes.*

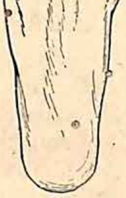


Trace the shape of it with a pencil on a sheet of white paper.

Now let one of the girls remove her own boot, and stand with her stocking-foot on the same sheet of paper. As she does so show that **the toes naturally spread out**—*the feet have to bear the entire weight of the body.*



Trace the shape of the foot on the paper with the pencil, and compare this **natural shape** *with the shape of* **the sole of the fashionable boot.**

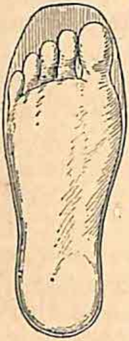


Sketch the shape of the boot on the tracing itself, and show that there can be no possible way of putting such a boot on, **except by cramping the foot** *into a much smaller space than it ought to have.*

Let the girls themselves point out that the **toes** *would be the parts to* **suffer most** *from this* **cramping**; *and then show a picture of a* **natural foot,** *side by side with one that has been* **distorted and deformed through improper boots.**

Point out that with feet such as this a girl loses all her **easy, graceful movements,** *and even her walk becomes little better than an* **awkward, ungainly hobble.**

This would be bad enough, but the trouble does not end here, for the pressure produces **corns** and **bunions,** which are a constant source of pain and discomfort.



Remember, it is much better in every way to have the boots **a little too large** than a little too small. They should have **broad soles, broad toes,** and **broad flat heels.** Common-sense boots of this kind produce no corns or bunions.

Call attention next to the boot as it stands on the table. Point out that the heel is raised considerably **higher than the toes**—*that the foot instead of resting flat on the ground is* **always on the slant.**

The result of this is that the weight of the body, instead of resting on the flat sole of the foot, is **thrown forward,** so that it all **rests on the toes,** and the natural balance of the body is disturbed.

Lead the children themselves to tell that the further result of this must be to **force the toes still more** *into the narrow pointed part of the boot at every step, and so add to the awkwardness and discomfort.*

Girls and women who wear these fashionable high-heeled boots are never able to walk any distance; neither can they move about quickly or gracefully.

More than this, these ridiculous heels, by disturbing the natural balance of the body, throw so much **extra strain on the calf of the leg** that this important muscle becomes weakened, and **even the spine** is liable to injury from the same cause.

Then, too, so small a portion of the heel itself actually touches the ground, that the wearer is in constant danger of **slipping** and **ricking her ankle.**

Common-sense boots, with **low broad flat heels,** are a great assistance, not a hindrance, in walking.

II. Common-sense Skirts

The clothing for winter weather should be warm **without being heavy.** It is a great mistake to wear a heavy weight of clothing. The **weight does not necessarily add to the warmth,** but it does add to the pressure on the body, and by its constant drag is very liable **to injure the spine,** and **displace important internal organs,** especially in the case of women.

Call attention to the **heavy weight of petticoats** *which girls and women usually wear* **suspended from the waist.** *Tell that the pressure caused by these, in addition to the stays, forces the important organs of the pelvis out of their proper position, interferes with their regular working, and very often is the cause of serious results in after-life.*

If petticoats are to be worn at all, they should be made of some **light non-conducting material,** and, instead of hanging with their weight on the waist, they should be **suspended from the shoulders** by means of braces.

Skirts and petticoats are at best **a source of fatigue and hindrance** to women in moving about, and some of them might safely be dispensed with, if the body were covered all over with flannel.

Tight skirts should always be avoided. They impede the free movements of the limbs in walking, and rob a girl of one of her chief attractions—her natural, easy, graceful carriage.

III. Common-sense Clothing for Children

Call attention next to the two little tin boxes, which have till now been hanging up in front of the class. The smaller one will probably be almost cold by this time, the other still warm, if not hot. This is not the point at present, however.

Compare the two in size. One measures **an inch each way,** *the other 2 inches.*

Tell that we call the small one **a cubic inch,** *and then, by drawing pencil lines on the other, make it clear to the class that this one is 8 times as big as that. It contains* **8 cubic inches.**

Point out next that each box has **six sides.** *The small one has* **6 square inches** *of surface, and the lines on the other will show that, in spite of its being 8 times as big, it has only* **24 square inches** *of surface.*

Tell that each box was filled with hot water from the kettle before the lesson began. Both have been parting with their heat all this time; but the little one is now **much colder** *than the other.*

How has the heat escaped from both of them? By **radiation** into the air.

Why did the little one get cold first? Because, in proportion to its size, it has **more surface** than the other from which the heat can escape.

Now that this is clear, let the small box represent **a child** and the large one **a grown-up person,** and you will quickly see that children require to be even **more warmly clad** than their elders, because they in like manner have **more surface** in comparison with their bulk.

Their clothing should be made of **light non-conducting material,** and all the garments should be **loose enough** to allow the body free play for all its movements.

Remember, **tight clothing does not add to the warmth.**

It is a great mistake for mothers to dress their little ones in such a way as to leave the **arms, legs, and chest bare and exposed,** with the desire of **bringing them up hardy.** Such treatment undoubtedly kills more children than it can ever harden.

Lesson XXIX

HOW TO DRESS WELL

Provide specimens of all the materials named in the lesson.

This lesson is intended to be a summary of practical hints culled from what has already been taught. It would be well to let the girls copy them into their exercise books one by one as they are given, in order that they may be committed to memory.

The hints are given here in brief. The teacher can make her own running comments as she dictates them.

I. Hints for Shopping

1. Make out a list of what you want, and do not be persuaded to buy other things merely **because they appear cheap,** and "will come in for something."

2. Always buy with **ready money.**

Point out that **with ready money** *in hand one is* **independent.** *If this shop does not suit we can go to another, and so we are always able to buy in the best market. But those who run bills are* **tied to one shop-keeper,** *and he will always make them pay for the accommodation* **by charging higher prices** *than his goods are worth.*

In this connection warn the girls especially against **the weekly tally-man**—*the worst of all forms of credit. Many a woman, by foolishly listening to the persuasion of the tally-man, has brought ruin on her home and her family. She has purchased articles in this way without the knowledge of her husband, hoping to be able to pay for them week by week. She has gone on perhaps for a time, but only to find herself* **drifting into debt and difficulties,** *and at last the end has come.*

3. Before going to shop always **consult some friend** older and more experienced than yourself, and **be guided by her advice.**

4. Let good useful underclothing be your first care, **for on this your health depends.**

Point out the absurdity of spending so much money on hats and bonnets, dresses and jackets, that there is little left for the purchase of the most important of all the clothing. Yet, because their underclothing is not seen, many silly girls do this, and so sacrifice their health to outside show.

5. Good materials may cost more, but they are **much cheaper in the end** than the so-called cheap ones.

Show how wrong it is to call low-priced inferior materials cheap. They may **be got up to deceive the eye,** *but they are really not worth the trouble and expense of making into clothing, for they have neither warmth nor durability in them. Such things are* **dear at any price.**

6. **Good flannel** is made entirely of wool, as you may see for yourselves by fraying out a few threads of the material. If, on examining the warp and woof threads in this way, you find **one set to be cotton,** be sure it is an inferior material, and avoid it, for it will be of very little service.

Show specimens of **Saxony** *and* **Welsh flannel.** *The first is the softest and warmest material* **for infants' wear**; *Welsh flannel makes the* **best skin garments** *for adults.*

Compare these with specimens of some of the inferior sorts of flannel.

Explain that there is **no economy** *in buying low-priced flannels or low-priced stockings, for even if the material happens to be all wool,* **it can only be shoddy wool** *at the price. It will not stand the wear and tear, and repeated washing.*

Low-priced stockings, even while they do last, are a source of constant discomfort and annoyance, for they are always **badly shaped,** and the roughly made seams are sure to **chafe and blister the feet.**

Show specimens, if possible, for the girls to examine.

7. **Calico** is best tested by **rubbing it** in the hand. If it is an inferior material, a **white powdery substance** will fall out of it as it is rubbed. This is a **dressing** made of British gum; it is laid on the inferior kinds of

calico **to deceive the eye** by filling up the spaces between the loosely-woven threads.

In good calico there is **very little of this dress,** the fabric is **closely woven** and **smooth,** and the **selvage** on either side is **straight** and **even.**

Unbleached calico is a very serviceable material for underclothing, and it is much cheaper than the white, bleached cloth. It must, however, be washed before it is made up, as **it always shrinks when it is first washed.**

Show specimens of all these, and let the girls examine them for themselves.

8. In buying prints always insist on having "**fast colours**"; in the cheaper kinds of prints the pattern will wash out when they are put into water.

Show some washed specimens of both.

9. Avoid **cheap finery** of every sort. It always has **a tawdry appearance,** and the first shower of rain will ruin it completely.

II. Useful Hints about Clothing

Point out that after buying good useful clothing we should learn to take care of it, so that it may last a long time, be comfortable to wear, and always look nice.

1. **The Outer Garments.**

Remind the class that these are mostly made of some sort of woollen material, and their **rough surface** *picks up and holds the particles of dust and dirt which are always floating about in the air. On wet days, too, they get more or less* **fouled with mud. Nothing spoils clothes so quickly as dirt of any sort.**

The dust and dirt are best removed by shaking and brushing.

A good shake *will get rid of the loose dust, but the more closely-clinging dirt requires* **a stiff brush** *to remove it. Remind the girls that they must not forget to brush the* **folds and creases** *of the garments as well as the other parts. Most of the dust and dirt lodges there.*

Mud must not be brushed off till it is dry, and even then it is often necessary **to sponge the parts** carefully, to remove the stains which the mud leaves behind.

Clothes must never be allowed to remain long in the mud and wet. As soon as they are taken off, they should be hung up to dry, and when quite dry they should be brushed, sponged where necessary, carefully pulled and stretched into shape, and folded up neatly and put away.

Benzine or **turpentine** will remove stains from clothing, for both are **solvents of grease.** Benzine is better for the purpose than turpentine, because the smell **does not hang about the clothing so long.**

2. The Underclothing.

All body-linen must be frequently changed and washed.

Remind the class that just as the outer garments become fouled with dirt and dust from outside, so the underclothing also becomes contaminated with the perspiration that **oozes through the skin from the inside** *of our bodies.*

Lead them to tell that this perspiration is **not merely water**—*that it contains* **bad poisonous matter,** *which the skin throws off, so that it may not do harm inside the body.*

Tell that this **body-dirt** *(as we called it in our last year's course) soon begins to decay, and it is that which makes people* **smell so offensively** *when they do not change their underlinen frequently.*

Explain also that the clothing itself suffers if it is worn too long, for then the dirt becomes so fixed in it that **the material is rubbed thin** *by the laundress in her efforts to remove it.*

The under-garments worn during the day **should be taken off,** and others put on for the night.

Those which are taken off should be hung carefully over a chair-back or the foot of the bedstead **to air during the night.**

III. A STITCH IN TIME SAVES NINE

Write the old proverb on the blackboard, and explain clearly what it means, as follows :—

1. Mend a thin place or a rent in the garment as soon as it is discovered; that will **prevent it from becoming an unsightly hole.**

Warn the girls especially against the slatternly habit which some have of pinning up a rent with a pin, and leaving it for some more convenient opportunity. Very frequently the opportunity does not arrive, and it is no uncommon thing to find thriftless people of this sort with their dresses torn and pinned up in many places.

2. All articles except stockings should be **mended before they go to the wash,** because the washing and rubbing would be sure to stretch the holes and make them larger, and then the task of mending would be much more difficult.

3. It is well not to wait for stockings and other woollen things to wear into actual holes before darning them. If they are carefully and neatly darned **in the thin weak places,** the darning will strengthen them, and **prevent them falling into holes,** and so the stitch in time will not only save nine, but will make the articles **wear much longer** than they otherwise would.

SECTION III.—WASHING

Lesson XXX

PREPARING FOR THE WASH

Provide for illustration a piece of clean white calico, similar pieces of the same material stained with ink, iron-mould, paint, coffee, wine, or fruit; a basin of milk, some salts of lemon, borax, common salt, and chloride of lime, a kettle of boiling water, and some common washing-soda.

I. INTRODUCTION

COMMENCE by reminding the children that in their last lesson they learned how to take care of their clothes; and elicit that one of the ways of doing this is by keeping them clean.

Lead them to tell that a good brushing is sufficient for some of the garments; others are made of materials that will wash, and these are changed and washed regularly.

Call upon them to explain why it is necessary to wash our clothes at all.

They are made dirty with **dust and dirt from without,** *and* **perspiration from within the body.**

Remind them that we do not notice the dust around us except on dry windy days, although the air is always laden with it. Point out that, if we leave a room ever so neat and tidy, we find it necessary after a time to go round with the duster, because **the dust from the air settles on the furniture.**

Tell that it is the same dust which **settles on our hands**

and face, *and makes, them dirty—it is the same dust that* **makes our clothes dirty.**

Elicit that the dirt **which comes from within the body** *in the form of perspiration, and soaks into our clothing, is worse than this outside dirt,* **because it is poison matter.**

It would be well at this stage, without entering into any details connected with the sebaceous glands or the structure of the skin (subjects which are reserved by the code for the next year's course), to mention that other matters are thrown off from the surface of the body besides the perspiration.

The children already know that the skin consists of two layers. Tell briefly that the surface layer is of **a scaly nature,** *that these scales are* **constantly being rubbed off** *in little particles by the clothing, and that, like all other dead matter, they at once begin to decay.* **Decaying matter of all kinds is poisonous.**

Explain that besides this there is always a certain amount of **greasy, oily matter** *oozing through the skin. It is this oil which makes the skin soft and supple, and prevents it from cracking; but if it is allowed to collect on the skin and the underclothing* **it soon turns rancid.** *It is the smell of this rancid oily matter which makes people with a dirty skin and dirty clothes so unbearable.*

II. SORTING AND MENDING

Now that we clearly understand the reason why our clothes must be washed, we will proceed to deal with the work of washing.

The first thing to notice in connection with this is that as each washing-day comes round other dirty things besides clothes have to be washed.

Lead the girls themselves to enumerate such things as **bed-linen, blankets,** *and* **quilts, window-curtains, table-linen, towels, dusters,** *and* **house-cloths.**

Remind them that, although these things must be washed as *well as the actual clothing, they are not all made of the same material, and some are much dirtier than others.*

The soiled articles could not be washed all together because—

1. Different materials **require different treatment.**

2. The very dirty things **would spoil the colour of the others.**

What, then, must be the first step in preparing for the wash? To put the different sorts of articles **into separate heaps,** so that they may be **washed separately** from the rest.

Explain that this is called **sorting the things,** *and proceed to show the principle on which it is done. The teacher should write on the blackboard the name of each heap, and call upon the class to give individual articles belonging to it. Let the children make a list of these as they are named.*

1. **Fine things.**—(*White shirts, cuffs, and collars, and laces.*)

2. **Table-linen.**

3. **Bed and body linen.**—(*Including sheets, pillow-slips, night-dresses, and bed-room towels, in addition to the ordinary day garments.*)

4. **Handkerchiefs.**—(*These, although they belong to the fine things, must be washed separately, because of the unpleasant nature of the dirt in them.*)

5. **Prints and other coloured things.**—(*Children's frocks and pinafores; print dresses and aprons.*)

6. **Flannels.**—(*Woollen materials of all sorts except stockings.*)

7. **Socks and stockings.**

8. **Coarse things.**—(*Such as coarse aprons, kitchen towels, dusters, etc.*)

Remind them next of what was said in the last lesson about the stitch in time that saves nine. Tell that the thrifty housewife always takes this opportunity of attending to any article that requires mending. Why?

This does not apply to **socks and stockings**; *they are always* **mended after they are washed.** *Why?*

III. Removing Stains

Point out that it is no uncommon thing for the clothes, table-linen, and other articles to be stained and spotted by accident, sometimes with ink, sometimes with **paint, fruit, tea and coffee, iron-mould.**

Explain that these stains must all be removed before the things are put into the water to be washed, as the ordinary washing will not remove them. **The soap** *used in the washing would only* **help to fix them more.**

It is best to remove all stains, if possible, **at the time of the accident,** for if they are left long without being attended to, they are likely to become fixed, and then the strong measures that have to be taken **tend to destroy the material.**

If they have not been dealt with before, they must receive special attention at the time of sorting the clothes.

Let us notice some of the methods of removing the various stains.

It would interest the girls if these operations could be shown experimentally.

1. **Ink and iron-mould.**

(*a*) **Ink stains.**—*Spill some ink on a piece of calico, and* **while it is still wet,** *put it into* **a basin of milk.** *After allowing it to soak for a minute or so, let one of the girls come to the front and rub it in her hands. The stain will quickly begin to disappear, and if the material is squeezed out and rinsed in clear water, scarcely any trace of it will be left.* **Milk will often remove a fresh ink stain.**

Now show a similar piece of calico with **an old dried ink-stain** *on it. Explain that milk would not remove this stain, as it did the other, because it has had time to* **become fixed** *in the material.*

Wet the stained part all over with cold water, stretch it tightly over the top of the basin, and rub it well with **salts of lemon.** *That done, pour warm water over it slowly and carefully, and as the water trickles through into the basin the stain will disappear.*

(*b*) **Iron-mould.**—This, like the old ink-stain, is best removed with **salts of lemon,** but in both cases the salts of lemon must be used sparingly, for it is an acid, and **is likely to rot and destroy the material.**

Wet the iron-moulded part of the material well, and stretch it over a basin of boiling water. Then rub the salts of lemon on it, and afterwards pour boiling water slowly and carefully all over the place. The article must be well rinsed in warm water **to get rid of every trace of the destructive acid.**

2. **Fruit and wine stains.**—These, like most other stains, are easier to deal with as soon as they are made, than if they are left to dry, and become fixed in the material.

Rub the stained part well with **salt,** *stretch it over a basin, and pour boiling water over it.* **Salt will remove a fresh fruit stain.**

If the stain is allowed to dry, it may be removed with **chloride of lime.**

Show some of the powder. The children have been made familiar with it in the lesson on **bleaching.** *Tell that it removes the stain* **by destroying the colour;** *but that unless it is used with care, it will* **destroy the material too.**

The powder itself must not come into contact with the material.

Make a very weak solution of it, filter the solution in the usual way through blotting-paper, and dip the stained part in **the clear filtered liquid,** *allowing it time to get thoroughly soaked. It must then be well rinsed in boiling water.*

3. **Paint.**—**Turpentine** is a solvent for the oily part of the paint. It removes the stain **by dissolving this oil.** It is the best thing to use for **grease stains of all kinds.**

4. **Tea and coffee stains.**—A little **borax** dissolved in boiling water is best for this. The stained part should be stretched over a basin, and the boiling water poured gently and slowly over it. **Borax removes tea and coffee stains.**

IV. SOAKING OR STEEPING

The last step in the preparation is to lay the clothes in soak.

Explain that this is for the purpose of **loosening the dirt,** *so as to make the actual work of washing easier; and proceed to deal with the following points, one by one:—*

1. Hot water must **never be used** for this; it would **fix the dirt** in the things instead of loosening it. Cold water will do for ordinary things, but **tepid water is best,** especially for those that are very dirty.

2. Soda is very useful in helping to **loosen and dissolve the grease** and dirt; but it **must not be used for the fine white things,** as it would **turn them yellow.** For these things a handful of **borax** is put into the water instead of soda.

Explain that even in using soda for other things care is required.

The solid **soda itself should not be thrown into the water** *with the clothes, for it would* **cause them to rot** *if it touched them. It must be* **dissolved in boiling water,** *and then the solution must be left to get cool before it is used.*

3. Those parts of the garments which are the most soiled, such as the collars and wrist-bands of shirts, should be **well rubbed with soap** before they are pressed down into the water.

4. A handful of **salt** thrown into the water in which the **handkerchiefs** are to soak will make them easier to wash.

5. Flannels and coloured things are **not to be soaked.** We will explain the reason for this in another lesson.

Lesson XXXI

WASHING-DAY

The teacher will require specimens of common soda, borax, washing and soap powders, a small article of some sort that has been washed and dried without rinsing, some stone-blue and a blue-bag, a basin of water.

I. INTRODUCTION

COMMENCE with a brief recapitulation of the last lesson so far as the preparatory work of sorting and soaking is concerned. Elicit from the class the reasons for both operations.

Point out that, if the soaking is to be of any service in loosening the dirt, it will require time. Tell that the clothes ought to have a good **twelve hours' soaking** *to make them ready for the wash, and show from this that all the work of preparation must be done,* **not on the washing-day itself,** *but the day before.*

Show too the wisdom of the good house-wife, **in commencing her work early** *in the morning, for then she has a better chance, not only of clearing off the actual washing, but of getting* **the greater part of the things,** *if not all of them,* **dried** *during the day.*

This explains why she does not consider her work of preparation over, till she has filled the copper and laid the fire in readiness for the next morning.

Tell that in every well-regulated home washing-day always comes **early in the week,** *and for a similar reason. It clears the dirty clothes out of the way, and also gives ample time for the other necessary operations of mangling, ironing, and airing.*

The last operation **(airing),** which is so essential to the health of the whole family, is **very likely to be neglected,** if through thriftless habit the washing-day is put off till late in the week.

Let us now turn our attention to the actual work of washing-day.

II. WASHING

Elicit from the class that the first step will be to light the copper fire which was laid in readiness the night before.

While the water in the copper is getting hot, the clothes that were left in soak should be wrung out loosely, and placed to drain, while the tubs are got ready.

Tell that the usual order of the wash is as follows:— **flannels, stockings, coloured things, fine things, table-linen, bed and body linen,** *and* **coarse things**; *but explain that, as flannels, stockings, and coloured materials require special treatment, we shall for the present leave them out of consideration, and confine our attention to the rest.*

Firsting. This is the name which is commonly given to the first process.

(1) The clothes, which were left to drain after soaking, are put into the tub, and some of the boiling water from the copper is poured on them. This of course becomes cooler as it touches the cold wet things, and as soon as the hands can bear the heat, the work of washing may commence, as follows:—

(2) Soap the things **on the outside** and rub them well, till the dirt is removed.

(3) When this is done, **turn the garments**, one by one; wring them out of the water, and empty the dirty water away.

In connection with this, impress upon the girls that:—

(*a*) **Only a few articles** should be put into the tub at one time, *as it is impossible to wash a heap of things properly.*

(*b*) The copper **must be filled up again** every time water is taken out of it, *or there will be no more hot water for the next part of the work.*

(*c*) The **clothes are to be rubbed,** and **not their hands.**

Tell that if they rub the clothes **with their hands,** *instead of rubbing one part against another, they will not only* **rub them into holes,** *but they will* **rub the skin off their hands** *as well.*

Seconding. Put the clothes into the tub once more, fill up with more hot water from the copper, and repeat the process—this time soaping and rubbing the things **on the wrong side.**

This finishes the washing. Each article must next be **wrung out** and placed ready for the next process—**boiling.**

Before leaving this, point out the necessity of **emptying the dirty water** *out of the tubs each time, and supplying its place with fresh hot water from the copper, in readiness for the next batch of articles.*

Lazy people, who to save themselves a little trouble wash one batch of things after another in the same water, can scarcely expect their clothes to be a good colour. They actually **wash the stain of the dirt from one article into another.**

III. BOILING

Before putting the clothes into the copper, take enough hot water out of it to fill up the tubs, and at once supply its place with cold.

Explain that this is done not only to provide more hot water to wash the other things, but because it would **fix the dirt in the things** *instead of removing it, if they were* **put into boiling water.**

The water in the copper **is only warm** (not hot) when the clothes are put into it.

Washing-powder, soda-solution, and **shredded soap** are added to the water to soften it.

The children have been made familiar with all the washing aids in the earlier lessons.

As each garment is put into the water it is **pressed**

down with the copper-stick, and the water is then left **to come to the boil gradually.**

Explain that in this way all the **dirt stains** *that still remain after the washing* **are boiled out,** *and the clothes are kept a good colour.*

They should boil for about **a quarter of an hour** or **twenty minutes**—not longer, for that would **turn the things yellow.**

As the boiling goes on, the clothes will be forced up continually above the surface of the water, and they must be pressed down from time to time with the copper-stick.

IV. Rinsing

When the boiling is over, each article is lifted out of the copper with the copper-stick, and left to drain.

When most of the copper water has drained out, the things are thrown into a tub of **clear cold water,** and moved about in it, **to remove** as much of the **soap and soda** as possible. We call this the **First Rinsing.**

Show a small article of some sort, that has been washed and dried without rinsing. As it is handed round the class, the girls will at once detect the **strong disagreeable smell of soap** *which still clings to it.*

One object of the rinsing is **to get rid of this soapy smell.**

Remind them next of the destructive power of soda. If the soap were left in the clothes through careless rinsing, the soda in it would soon cause the material to rot, for **it is very destructive to the fibre of all cotton and linen fabrics.**

Rinsing is necessary, therefore, for the sake of economy. It saves the material from any injury which the soda might cause.

After this first rinsing the things are removed from the water, wrung tight and shaken out; and then they have to undergo **a second rinsing.**

The rinsing water this time is **made blue,** by squeezing the blue-bag in it; and this is why the process is sometimes called **Blueing.**

Lead the children to tell that another of the bad effects of soda is that it **turns cotton and linen materials yellow.**

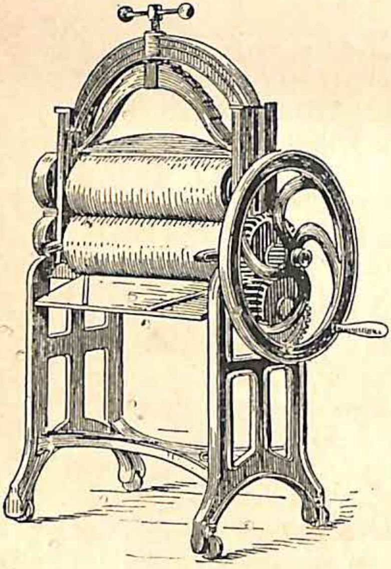
The object of the blueing is **to get rid of the yellow tint,** which the soda is apt to give the clothes.

Explain that very great care is required in this process, because although we want to get rid of the yellow tint, **we do not want to make the clothes blue.**

If the blue-bag is properly used, the clothes will be **a good pure white.**

The amount of blue in the rinsing water will be just sufficient to destroy the yellow tint of the soda, that is all.

If too much blue is used, we do not merely get rid of the yellow tint, but we actually **dye the clothes blue,** instead of making them white.



If the blue is not well stirred up in the water before the clothes are put into it, they will come out **disfigured with streaks and spots of blue.**

Show the children, by squeezing a blue-bag into a basin of water, how to test the colour. If a little of it when taken up in the hand has **the blue appearance of the sky,** *it is fit for use as rinsing water. It would make the material rinsed in it a good colour,* **without making it too blue.**

Show the result when too much blue is used.

Nothing remains after the blueing process but to wring the articles out very tight, to remove as much of the water as possible, and then they are ready to be hung out in the drying-ground.

Lesson XXXII

HOW TO WASH

Articles required for illustration: a fine lace collar, a small brush and a washing-board, a handkerchief, a piece of new flannel, specimens of badly-washed prints, a well-cared-for print pinafore or apron.

I. INTRODUCTION

Lead the children to recapitulate, step by step, the various processes described in the previous lesson.

This done, explain that all articles of household linen, bed and body linen must undergo the same treatment of soaking, washing, boiling and rinsing.

We must now turn our attention to the way of dealing with the rest of the articles which require washing.

II. FINE THINGS

Elicit that under this head are included **white shirts, cuffs, collars, muslins,** *and* **lace articles,** *of all sorts, and, generally speaking, all such things as require to be kept spotlessly white.*

Point out that these things are all much more delicate in texture than the ordinary household linen, and that therefore **they require separate treatment.**

Here is a lace collar. Would you recommend soaking for this before it is put into the wash-tub? Yes.

Why? Because the **soaking would loosen the**

dirt, and it would not want so much hard rubbing to move it.

What would you put into the water to assist in loosening the dirt? Some borax.

Why not use soda? Because soda would help to **destroy the fine material,** and **turn it yellow.**

Explain that in the washing itself these fine things must have the most careful handling. **Hard rubbing would tear and spoil them.**

It is advisable to tie them up in a muslin bag before putting them into the copper to boil. This will save them from all chance of **iron-mould**, and also protect them from the **scum** which rises to the surface of the water as the boiling goes on. This scum would **turn them a bad colour** if it settled on them.

III. POCKET-HANDKERCHIEFS

Pocket-handkerchiefs really belong to the fine things, but the uses to which they are put make them so disagreeable to wash that they require separate treatment.

You remember, to begin with, that we **soak them** by themselves **in salt and water,** because the salt helps the nasty slimy dirt to slip more easily out of the material. They should be moved to and fro in the soaking-water, and wrung out loosely with as little handling as possible, after which they should be washed by themselves, or better still **scrubbed lightly** with a small brush kept for the purpose.

Point out that the scrubbing **must be done with care,** *because of the fine delicate nature of the material. It is best done by holding the handkerchief in one hand, and scrubbing it lightly in one direction with the other.*

Spread a handkerchief on a washing-board and show how this should be done.

This partial cleansing of the handkerchiefs should always be carried out first of all, because when they have been cleansed from that unpleasant dirt, they are ready to go into the regular wash **with the other fine things.**

IV. WOOLLENS

Call upon the class to enumerate the various articles of clothing made of wool, such as **under-vests, flannel petticoats, chemises, drawers, socks,** *and* **stockings.**

Point out that woollen materials of all kinds are **looser in texture** *than other materials, that their threads are* **more easily pulled apart and broken,** *and that the surface is covered with a* **soft woolly nap.** *Show this in a piece of new flannel.*

Explain that these woollen garments are **the most important part** *of our underclothing, and* **cost more money** *than any of the others. It is of course necessary to get the dirt out of them, but in doing this every care must be taken* **not to spoil them.**

Nothing so soon spoils flannels and woollen materials of any kind as **bad careless washing.**

In washing these things the following rules must be observed:—

1. They are **not to be soaked** previous to washing.
2. Soap **is not to be rubbed on them.**
3. **No soda** is to be used in the water.
4. They are **not to be rubbed** or **wrung out.**
5. They are **not to be boiled.**

Explain that such treatment, although suitable for other materials, would cause flannels **to shrink up,** *and* **become matted** *into a thick hard sort of felt.*

It would to a large extent **destroy the porous nature** *of the material, which is one of its most important properties.*

Show specimens of flannel which have been spoiled by improper washing, and compare them with others which have been washed in accordance with the above rules.

The proper way to prepare for washing flannels is to cut **thin shavings of soap** into a basin of boiling water, and when the soap is all dissolved, pour it into a tub half filled with **tepid water.**

If this is stirred about with the hands **a lather soon forms,** and the flannels are put straight into this **without any previous soaking.**

There must be **no rubbing.** The articles are dipped up and down in the water, and **pulled loosely through the hands.** This is quite sufficient to remove the dirt from these loose porous materials.

When most of the dirt has been got rid of in this manner, the dirty water should be emptied away, and the same kind of washing repeated **in a second lather,** till the things look clean.

Nothing more is to be done except to **rinse the articles** one by one in clear lukewarm water, to get rid of the soap.

They should then be squeezed through the hands to press out as much of the water as possible; but **they must not be wrung.**

A good shake afterwards will help **to bring up the woolly nap,** and then they are ready to be hung out to dry.

Explain that for flannels, as well as other things, open-air drying is the best. If, through bad weather, they have to be dried in the house **they must not be put too near the fire,** *as that would cause them to shrink and become hard.*

Stockings are washed **first on the outside,** then turned inside out and washed again; after which nothing remains but to rinse them in clear lukewarm water, and hang them out just as they are to dry.

V. PRINTS AND COLOURED THINGS

Coloured things require as much care as flannels, not for the sake of the material itself, but to prevent the colours from running.

Observe the following rules:—

1. They must **not be soaked** previous to washing.

2. **Neither soda nor washing powder** must be used.

3. They must **not be boiled.**

4. They must **not be kept too long in the water.**

5. The water must **not be too hot.**

6. They must be **wrung out very dry,** and dried as quickly as possible.

7. They must **not be hung in the sun.**

Point out that all these precautions are necessary **to prevent the colours from fading.**

Show specimens of prints in which the colours have faded through careless washing, and compare them with an apron or a pinafore which must have been washed many times, and yet retains its bright colours, because it has been treated properly.

Tell that the great secret in washing these coloured things is to get the work over as quickly as possible, so as to remove all the dirt **without giving the colours time to fade.**

Explain that, like flannels, they should be washed in a soap lather.

They should be washed quickly **first on the right side,** *and then on the wrong, and afterwards rinsed in clear cold water.*

In rinsing prints **a little salt** *or* **vinegar** *added to the water will help to fix the colours.*

Lesson XXXIII

DRYING AND FOLDING

Provide the following articles for illustration:—a linen cloth, a basin of water, some article of underclothing which has been washed and left rough dry, a clean white cloth for the table, a sheet for folding.

I. DRYING

1. **Introduction.**—*Introduce the new subject by leading the girls to tell from their own observation at home on washing-*

day that mother is always more anxious about the drying than about the actual washing of the clothes.

Point out that this is the natural result of a climate like ours, and proceed to show the reason why.

We see the wet clothes hang out on the lines, and we know that after a time they will be taken in quite dry. But what happens to them as they hang there?

Why do they get dry? What becomes of the water that is in them? Let us see.

Dip a cloth in a basin of water, wring it out, and hang it in front of the fire.

Call attention to the **vapour rising from it.**

What is going on? The water in the cloth is being **evaporated or changed into vapour.**

What becomes of the vapour? It **disappears** in the air.

When will the cloth be quite dry? When all the water which is now in it is **evaporated.**

Compare this with the pavements on a wet day. When the rain is over they become dry again, because the water changes into vapour and **disappears in the air.**

Remind the children that sometimes the pavements dry up very rapidly after the rain, but on other occasions they remain wet for a long time. Why is this?

Explain that evaporation can go on only when the air is dry. **Dry air is very thirsty for moisture.** *It changes water into vapour wherever it meets with it, and sucks up or* **absorbs this vapour** *as it flies off.* This is why the vapour seems to disappear.

On a dull wet day the air is already full of moisture, and **cannot take in any more.** Little or no evaporation can go on—the pavements remain wet.

On such a day **clothes will not dry out of doors,** but even on a very cold day they will dry quickly, provided there is a keen dry air about.

A light breeze, **without too much sun,** is the best weather for drying.

2. **Indoor Drying.**—*Elicit that sometimes, owing to the*

bad weather, the drying has to be done indoors. Tell that this should never be done **except under compulsion,** *for clothes which are dried in the open air are always* **fresher, sweeter,** *and* **purer**—*better in every way—than those that are dried in the house.*

Drying in the house is **bad for the clothes,** and **bad for ourselves** as well.

The clothes, instead of smelling sweet and fresh, as they do when they are dried in the open air, never seem to quite lose the **smell of the soap-suds.**

Flannels and coloured things are very liable to be spoiled through being hung too near the fire when they are dried indoors. This will cause flannels to **run up and shrink,** and **become hard**; and it will **fade the colours of prints and muslins.**

Picture the discomfort of the home with wet clothes hanging about, and then point out that it is not only unpleasant but very unhealthy, for **rheumatism** *and* **colds** *are almost sure to follow, because of the damp which fills the air of the house.*

Whenever, through the compulsion of bad weather, the clothes have to be dried indoors, the drying should always be done **in one room,** which should be kept closed and have **a good fire** burning in it, in order to get it over as quickly as possible.

3. **Hints on Drying.**

(*a*) The clothes should always be hung on lines, **never thrown across bushes, hedges,** or **palings.**

Show the reason for this by setting one of the girls to rub the piece of branch with a damp white cloth, and then hold up the cloth before the class.

Where did all this dirt come from? Tell that there are always **smuts from the chimneys,** *and other particles of* **dirt,** *and* **dust,** *floating about in the air, and some of these* **must settle on the bushes and palings.** *They would make the clean clothes dirty again, and so* **spoil all the work of washing.**

Point out too that there is a great risk of **getting the**

things torn *by the bushes and palings if the wind is at all strong.*

Tell that careless people often spoil their own work, even when they hang the clothes out on lines, because they do not first take the trouble to see that **the lines** *and the* **clothes' pegs** *are* **quite clean.**

(*b*) When no longer required the lines should be taken in, made up into a coil, and hung on a peg in the wash-house. This will not only **keep them clean** till they are wanted again, but will also **save them from rotting** through exposure to the weather.

For a similar reason the pegs should be collected up in a basket, and **not thrown on the ground** when the clothes are taken in.

Tell that care is required in hanging out the clothes. The great object is to hang them so that **the water may drain out** *of them, and* **the air blow through them** *without any risk of getting the things torn if the wind is strong.*

(*c*) Hang up **each article separately,** body-linen, pillow-slips, etc., **inside out,** just as they are left after washing.

(*d*) **Shake each article** out well before it is put on the line.

(*e*) Articles of body-linen should be hung up **by the thickest parts,** because there is then less risk of their being torn in the wind, and it gives the water a better chance of draining out.

(*f*) Thread cuffs and collars and other small things on a string through the buttonholes, and tie them up to the lines. **This saves pegging them up one by one.**

(*g*) Peg up stockings **separately by the toes.**

(*h*) Sheets and tablecloths should be pegged up by the two hems, so that they hang **like a sort of bag.** The wind in this way blows through the bag, and soon dries them.

(*i*) Prints and other coloured things must **not be hung in the hot sun** or they will quickly fade.

(*k*) Wooden pegs, **not pins,** should be used to fasten the clothes to the lines, for pins are very likely to **tear** them.

(f) When the lines are full, **prop them up well** with tall poles. This will not only save the large articles from dragging the ground, and being blown against walls and trees, but will also hoist them up well into the air. **The more air they get, the sweeter and whiter they will be.**

Remind the girls that the **flannels, stockings,** *and* **coloured things** *are always* **washed first,** *and explain the reason. The woollen material of the flannels and stockings* **takes longer to dry** *than the calico and linen articles—the coloured things* **must be dried as quickly as possible** *to prevent them from fading. Hence these things are washed first and hung out in the early part of the day.*

II. FOLDING

Elicit from the class that the clean rough-dry clothes, after they are taken in from the lines, have to be mangled and ironed to give the material a smooth glossy surface.

Tell that before this can be done each article must be **neatly and carefully folded,** *and proceed to show (experimentally if possible) how this part of the work is to be done.*

Spread a **clean white cloth** *on the table, and impress upon the girls the necessity of having* **clean hands** *for the work.*

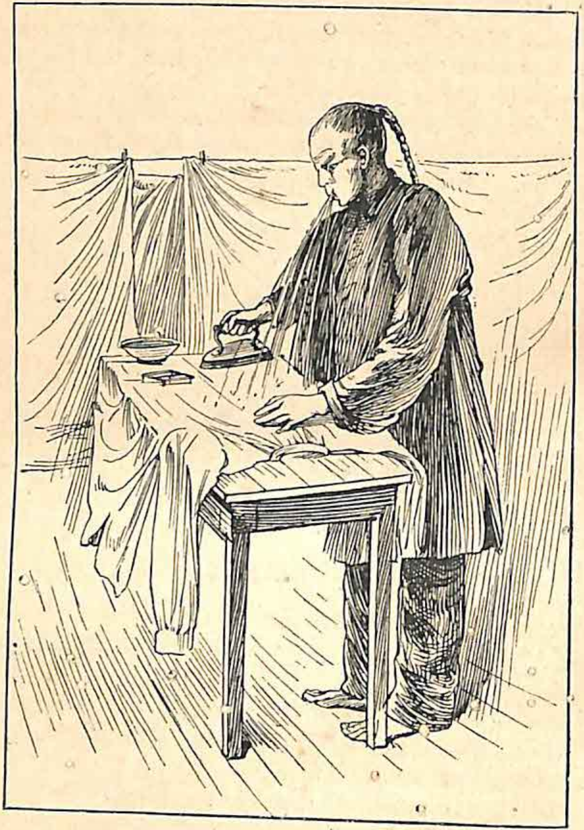
Take some rough-dry article of body-linen. Show that it has been **dried on the wrong side,** *and that therefore the first step must be* **to turn it.** *Do this,* **shaking it** *out well and* **pulling it into shape** *at the same time.*

Call attention next to the **basin of clean cold water** *which stands on the table, and show its use* **by sprinkling** *some of it on the garment with the hand.*

Explain that all articles **require to be damped** *in this way. If they were left dry, the mangling and ironing* **would not smooth them.**

It would amuse the girls to hear how John Chinaman does this part of the work.

Explain that in America most of the washing is done by Chinese laundrymen. Instead of dipping their hand into the basin and sprinkling the clothes as we do, they take the water into their mouths and blow it over them in a stream.



Proceed next to fold up the article neatly and evenly on the table, taking care to fit **corner to corner,** *and* **seam to seam.** *When that is done, show that it is folded up* **very**

close and tight. *Explain that all articles must be treated in this way, and then* **left to stand** *for some time, before they are mangled or ironed, in order that* **the damp may spread** *uniformly through them. Unless this is done they will not look well after the mangling.*

Sheets and tablecloths require two people to fold them. They should be well shaken and stretched, and the corners folded carefully together.

All flannels should be folded as soon as possible after they are brought in, as **this prevents them from getting creased.**

Lesson XXXIV

MANGLING, IRONING, STARCHING, AIRING

Have ready at hand for illustration a clean linen collar, some starch, a basin, a jug of cold water, and a kettle of boiling water, some borax, turpentine, white wax, a white shirt, a newly-mangled article of some kind.

I. Mangling and Ironing

Commence by referring once more to the work of folding the clothes, and lead the girls to tell why so much care is necessary in this.

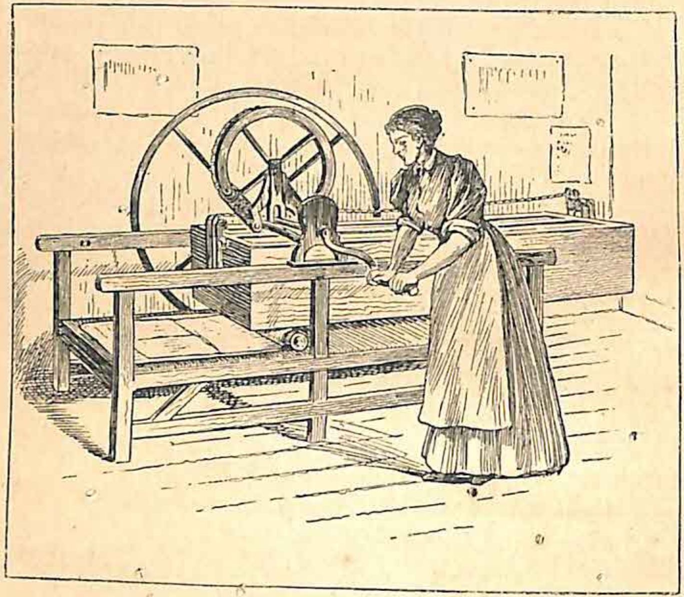
Clothes that are carelessly folded can never be made to look well, because **good mangling** and **good ironing** depend upon **good folding.**

Why is it necessary to damp the clothes? Why is each article folded up very tightly, and left to stand for a time before it is put into the mangle?

After refreshing the memory in some such way as this, proceed to tell that all table-linen and body-linen ought to be **mangled first** *and* **ironed afterwards,** *as this gives the things* **a much better appearance** *than they would get from* *either mangling or ironing alone, and* **makes them last clean longer.**

Explain that as a rule the bed-linen is only mangled, but wherever it is possible these things too should be ironed afterwards, for like the other articles they always look much better for it.

The mangling process is no doubt familiar to most girls. Describe briefly the old-fashioned mangle, with its smooth bed and rollers, and the great heavily loaded chest which moves backwards and forwards over them. Show a picture if possible. Tell that it is the **pressure of this heavy weight** *passing over the rollers which gives the mangled articles their* **smooth glossy surface.**



Flannel petticoats and underskirts should be ironed after they come from the mangle; but the iron must only be moderately hot, as **flannel easily scorches.**

Handkerchiefs **are not mangled.** They should be damped down, and **ironed damp,** as this gives them a

glossy surface, and makes them **very smooth** and **pleasant to the touch.**

II. STARCHING

Show a clean linen collar. Elicit that this article has been ironed, but before it was fit to iron it had to undergo another process—**starching.**

Lead the children to enumerate the various articles which have to be starched before they are ironed, such as the **linen fronts** *and* **wristbands** *of shirts,* **laces, cuffs, embroidery** *and* **frilled things** *of all sorts,* **muslins** *and* **window-curtains, print dresses, aprons, pinafores,** *and* **table-linen.**

Tell that the object of starching those things is (a) *to make them* **stiff,** (b) *to give them a* **smooth glossy** *appearance,* (c) *to help them* **to keep clean longer** *than they otherwise would.*

1. How to prepare the Starch.

Point out that in the starching as well as in the washing, each article requires its own special treatment, and this explains why starch is prepared in two ways in the laundry.

Cold-water starch is best for **shirt-fronts, collars,** and **cuffs** and all linen articles; **boiled** or **hot-water starch** for **prints, muslins,** and **lace things.**

(*a*) **Cold-water starch.** *Mix some starch with cold water in a basin. Show that it is easily made, but it is necessary to see that it is* **smooth** *like cream, and entirely* **free from lumps.**

A little **borax** should be dissolved in boiling water and added to the starch when cold, as this **helps to whiten the linen.**

Two or three drops of **turpentine** will assist the starch to give the linen a **fine gloss.** Too much must not be used, and it must be well stirred into the starch, as it **has a tendency to rot the linen.**

(*b*) **Hot-water starch.** *Proceed next to show how this is made. The starch is mixed as before with cold water into a smooth creamy-looking paste, and then boiling water is added to* *it. It must be kept well stirred, as the boiling water is poured into it.*

Call attention to the change which the boiling water sets up. The starch granules are insoluble in cold water; but the boiling water causes them to **swell and burst open,** *so that the starchy matter in them is set free.*

As before, a little **dissolved borax** should be added to the starch, and a few **shreds of white wax** is useful in preventing the iron from sticking.

2. **How to use the Starch.**

If this could be actually done before the class, it would be much more effective than a mere description. Suppose the article to be a white shirt.

Take the front first, and dip it into the cold starch with one hand, while the other is employed in stirring and moving the starch about, and **squeezing the linen well** *to make sure that every part of it gets* **thoroughly wetted.**

Then wring out the front as tight as possible, and treat the wristbands in the same way. That done, put front and wristbands together, and **fold up the shirt very tight,** *at the same time sprinkling a little cold water on the other parts.*

Tell that, like the shirt-front itself, cuffs and collars have to be made very stiff. The starch must be squeezed well into them, and then they must be folded up very tight, and left to lie in the starch for **about an hour** *before they are ironed.*

Table-linen, prints, and muslins do not require to be made as stiff as shirt-fronts and collars. **Thinly-made boiled starch** is used for them, they are simply dipped into it and wrung out, and **they are not rolled up after starching,** but hung on a line to dry.

When dried they are **damped down** (sprinkled with clean cold water) and then rolled up tightly and left for a while. After this they are **carefully folded ready for mangling,** if they are to be mangled as well as ironed.

III. AIRING

So much stress has been laid on the need of damping down the clothes in preparation for the finishing work of mangling and ironing, that the present will form a good opportunity of impressing upon the girls the more-than-equal necessity of **thoroughly airing the clothes** *after those two operations are completed.*

It will in fact appeal to them more forcibly than if it were left to be dealt with in its natural order.

Show an article of some sort just as it has come from the mangle. It is probably **very damp**—*not to say wet. Hang it in front of the fire, and call attention to the* **vapour which rises from it.**

Tell that on no account should clean clothes be put on, or **clean sheets be added to the bed,** *until they have been thoroughly aired.*

For our health's sake, this proper airing of the clothes after washing is the **most important part of the whole business**; and yet it is very often neglected, or at best done in a slovenly careless manner. Nothing will more certainly produce **colds, rheumatism, inflammation** and other evils of a like character, than **damp unaired clothes**; and **sleeping in damp sheets** almost always leads to **fatal results.**

Let the **airing of the clean clothes**—the ironed articles as well as those that are mangled—be at all times **a matter of serious care.** In the warm summer weather they will air in the bright sunshine; but at other times they must be hung on the clothes-horse round the kitchen fire, and they should be turned about on the horse to make sure that every particle of damp is dried out of them.

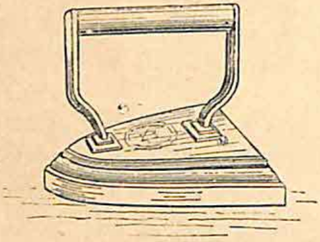
Lesson XXXV

THE WORK OF IRONING

The following articles will be required: a flat iron and a box-iron, picture of an ironing stove, a rough-dry starched shirt.

I. GENERAL RULES

1. **The irons.**—*Show a common* **flat-iron.** *It is of course a familiar object to all the girls. Lead them to tell that the ironer's first care must be her irons.*



She must see that they are (a) just hot enough, but **not too hot,** *or else they will* **scorch the things;** *(b)* **perfectly clean,** *or they will* **smudge** *and* **soil them.**

Tell that in most homes the irons are heated at an open fire, but in the laundry closed stoves usually take the place of open grates, and gas is often burned instead of coal.

When open fires are used the following rules must be observed:—

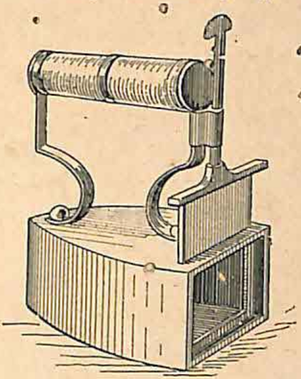
(*a*) The ironing fire must be clear and red-hot **without any smoke.**

(*b*) The irons must **not be put on the fire** itself, for the burning fuel, besides **making them black**, would also **eat away the smooth, polished ironing surface.**

(*c*) They must be **hung in front of the bars** by means of a hanger.

(*d*) If the fire needs replenishing, the live coals should be brought to the front, and fresh fuel added behind these, and the **bottom of the grate should be well raked out,** to keep up a good draught, so that the fire may burn with **as little smoke** as possible.

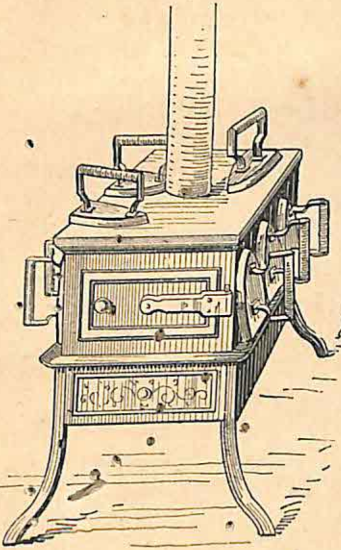
(*e*) Each iron **must be tested** before it is used. This is best done by rubbing it on a cloth kept for the purpose, which serves the double end of cleaning the iron, and showing whether it is fit for use.



Of course if it scorches the cloth, it is much too hot for ironing purposes, and must be stood aside for a while.

Tell that an experienced ironer can easily test the heat of her iron **by holding it up to her cheek.** *Show how she does it; but advise the girls that they had better trust to the cloth, as they are likely to let the iron slip, and burn their arms.*

Show a **box-iron,** *and explain that with this there is much less danger of either dirt or over-heating, as the iron itself is not put near the fire. The loose piece of iron from the inside* **(the heater)** *is plunged into the middle of the fire, and* **when it is red-hot** *it is taken out with the tongs, put into the box and* **shut up** *while the work of ironing goes on.*



Show a picture of the closed stove with the flat irons ranged on and round it.

Point out the advantages of such a stove over the open fire.

Tell that when gas is used for heating the irons, it **causes them to sweat,** *and* *this moisture will* **rust their smooth polished surface,** *if it is not carefully rubbed off.*

2. **The ironing table.**—*Explain that next in importance to the irons comes the* **ironing table,** *or* **ironing board.** *Tell that it must be covered either with* **thick felt,** *or a* **blanket folded double,** *and over this a* **clean white cloth must be stretched tight,** *so as to make a smooth surface entirely without wrinkles or creases. Each article must be* **spread out smoothly** *on the table before the iron is applied to it.*

II. HOW TO IRON

Proceed next to give a few simple directions for dealing with some of the common articles that require ironing.

1. Handkerchiefs are the simplest articles to iron, and yet they require care if they are to be ironed nicely.

Explain that these articles are always **ironed damp,** *and call upon the girls to give the reason—it makes them* **smooth and glossy** *and gives them a* **pleasant stiffness.**

Tell that they should be ironed first **along the borders,** *and then all over* **in the direction of the selvedge.**

Produce the handkerchief and show how it should be folded after the ironing. This requires much care.

2. The articles of under-linen, which have already been mangled, require little more than **smoothing over with a hot iron on the right side** to make them look nice, but the **tapes** and **frilling** must be **carefully ironed out.**

3. Table-cloths should be carefully ironed **on the right side,** as this helps to **bring up the gloss** which the mangling has given to the material.

4. Muslin, cambric, and embroidery are ironed **on the wrong side.**

Explain the reason for this.

(*a*) These things should **not have a glossy surface.**

(*b*) The **pattern** of the **embroidery,** and the dots or figures on the **muslin** (if there be any), **are thrown up** by the pressure of the hot iron on the wrong side.

The same thing applies to all materials with a raised pattern.

4. Print aprons, pinafores and dresses are ironed **on the right side.**

Remind the children that these things have already been starched and mangled, and the object of the ironing is **to stiffen them** *and give them* **an extra gloss.**

Tell that frocks and dresses require considerable care to make them look nice. The neck, sleeves, and body of the dress should be ironed first, and **the skirt last** *of all. The ironing of the skirt should be done in one direction,* **from the hem upwards** to **the gathers,** *and the pocket should be turned inside out and ironed* before commencing with the skirt.

III. Ironing a Shirt

Explain that no article requires such careful ironing as a white shirt, and for this reason many people prefer to send the shirts out to the steam laundry rather than risk the chance of spoiling them themselves.

Tell that this is probably because they have not been taught the right way of doing it. Every girl and every woman ought to know how to do it, and when once they know the proper way, they will soon improve with practice.

Proceed next to show the method of dealing with this article. Of course it would be infinitely better to do the work in front of the class if possible, but if this cannot be done, it should be described, with the help of the article itself.

Point out that it must first be **shaken out** *and* **pulled into shape,** *because it has been lying for some time rolled up tight in the starch.*

This done, **fold it down the middle** *of the back, and explain that this is the first part to be ironed, and then the* **thick part of the yoke** *must follow.*

Next the **sleeves** *one by one, and the* **body of the shirt** *are ironed, so that the* **starched parts are left till the last.**

Of these the **cuffs are always ironed first.** *Show that* *they must be pulled into shape and laid smoothly on the table* **with the wrong side up,** *as they have to be* **ironed first on the wrong side,** *then on the right side, and then once more on the wrong side. Explain that, when this has been done, the finishing gloss is given by pressing rather heavily on the right side* **with a fresh polishing iron.**

The front is the most important part of the shirt. For this a **small board** covered with **two or three thicknesses of flannel** is used. This is pushed under the front, the linen is pulled into proper shape, and the hot iron is run over it rather quickly several times, beginning at the lower part and **working up towards the collar band.**

As in the case of the cuffs the work is finished off with a fresh, hot, polishing iron.

THE END

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